THE

ELECTRICAL REVIEW.

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CONDUCTING STEAM PLANT TESTS.

IN measuring the consumption of feed water, it is often customary to tie a thread round the gauge glass and endeavour to finish the test with the water level at the thread which had been tied at the initial level. Mr. W. H. Wakeman, writing in *Machinery*, properly condemns the practice as less reliable than even a water meter, which is bad enough. It is difficult even to locate the water line upon a gauge glass, and even an error of an eighth of an inch may be serious. But this is not all; water expands with heat, and the difference of a few degrees will affect the bulk of water in a boiler. He takes it for granted that in such a measurement, quite apart from the above difficulty, the expansion of the water will affect the result, and this can hardly be allowed for in a short test. Water expands about 15 times as much as iron for an equal range of temperature, and if water shows an expansion of 14 units, we may take it that the boiler has expanded one unit, so that to the apparent expansion we need to add about 7 per cent. to correct for the temperature expansion of the boiler. But as water expands, so does the pressure in the boiler increase and the plates stretch—very little, it is true—but they do stretch under the increased tension. Starting with a cold boiler, and noting the expansion of the water, there are thus three correctives to apply: that for expansion of the plates by the accession of temperature, that for tension, and that for the compressibility of water by pressure—a very small one. Where a test is of considerable duration, however, it does not follow that there need be very great fear of serious irregularity creeping into results where tests are undertaken for commercial purposes alone, and not as absolute tests.

In conducting a commercial test where there are no results to be carped out, a work's manager can secure figures accurate enough for his purpose with a very trifling amount of attention. He will sometimes run a week on a certain coal and a week on another coal, and the fireman may hardly know that a test is being conducted. Under certain circumstances, the results are likely to be more fair than a trial of two consecutive weeks made with every precaution. The fireman goes on in his usual way and gets practical results, but let there be any serious preparations made, and he will endeavour to achieve something beyond the ordinary, and according to his temperament he will do better the first week and fall back again during the second, or he will progressively improve right through both tests, and thus the results will not be fair. Mr. Wakeman points out the many causes where errors can arise in these rough tests, such as the return of condensed water to the boiler where steam is used in coils, and so on. In every case, however, the various circumstances should be duly weighed, and the test conducted accordingly. In a factory run at a uniform load the year round, the simple weighing of the coal and measuring of the water by meter,

together with a daily measurement of feed water temperature, will secure fair comparative results, though both may be anything but accurate. Absolute accuracy of time keeping is not required in a chronometer, so long as its rate is uniform, and so it is with many commercial tests. Comparisons alone are needed, and if absolute results were wanted, they could not be had, by reason of the upset they would make in arrangements.

We would not decry accurate tests of steam plant; but we doubt very much if many accurate tests have ever been made by the apparently most particular engineers, who go the greatest lengths with their calorimeter tests, and have done so for a long time, though it has been very doubtful if any correct sample of steam has ever been secured. The thread on the gauge glass is accuracy itself, as compared with the percentages of moisture found in steam pipes. Practical engineers are not likely in the future to pay attention to any elaborate heat balance-sheets, unless there can be shown a thermometric reading of more or less superheat as a proof of the absence of moisture. The missing quantities in heat balance-sheets are perhaps more explicable now than they were when the calorimeter test was believed in.

Where Gas and Electricity Clash.

With the little experience gained from municipal electricity supply business we must confess that we are not enamoured of the arrangement under which a lighting committee controls both electricity and gas supply. It is obvious that one must suffer, and we are afraid it is generally electricity. It would not be difficult to give instances where a municipal electric supply is being not only neglected but is prevented from making progress by the steady opposition of lighting committees. A policy of that nature, if persisted in, means eventually a waste of ratepayers' money. We are confident that if the merits of electricity are properly brought before the lighting public, and charges are not excessive, there is bound to be an accession of consumers. The obligations of a lighting committee include, at least, fair dealing with the electrical works under their control. The neglect of electricity supply business when there is a remote possibility of it clashing with gas interests is not confined to municipalities, but we have rarely seen a statement on this subject so frank as one in a report of the Rockhampton Gas and Coke Company, Limited. This company owns gas and electrical plant, but says: "Adhering to the principle established from the date of the introduction of electric light into the company's business, strenuous care has been exercised to avoid a too rapid development of this section of the company's operations, to avoid an unnecessary clashing with the gas interests." Yet in spite of themselves they make a profit of £219 on the electrical operations.

A "Quid pro Quo."

A letter from the Electric Construction Company in our Correspondence columns draws attention to the fact that American engineering companies, supported by American capital, are rapidly acquiring a monopoly of electric traction business, not only in other countries, but actually in England and Ireland. As a set off against this we can point to the Cottonwood Water Power and Electric Company, Limited, with its £210,000 English capital, incorporated to carry the war into the enemy's camp, and to supply electrical current to the neighbourhood around Salt Lake City. It is stated in the prospectus that the vendor has already secured a contract, assignable to the company, for 1,000 horse-power for 10 years at $120 per horse-power per annum. Why it should be necessary to come to England for financial aid with a contract for £24,000 a year in hand is a mystery, but possibly the vendor, John Elliot Condict, is a true Briton, although we have a dim recollection of having previously seen his name in connection with purely American enterprise. The prospectus is a medley and requires careful perusal. In addition to acquiring water-power, with a minimum delivery of 2,000 horse-power, which is to be offered to customers at $100 per horse-power year, with lands, electrical plant, and accessories, the company will own several gold and silver mining *claims* which *promise* (the italics are ours) large returns. If there is anything in a name, the "Lucky Boys" claims may influence a certain class of speculators. It seems to us, as coal can be bought on the spot at from £1 to £1 10s. per ton, that a horse-power could be obtained from good steam plant, developing a large power, at considerably less than $100 a year, even for a 24 hour day. The wages of engine drivers and firemen are estimated at 10s. to 16s. per day, and although, quoting from the prospectus, "it is well known that after the first installation of water-power the expense of its maintenance is reduced to the small item of supervision," we are told nothing as to the rate of pay of dynamo tenders who would be required. This being so it is difficult to understand why the mining towns, sampling works, smelters, railways, mills, &c., within a radius of 16 miles, that now use steam to the extent of 10,000 horse-power, would be glad to take advantage of the economy which this company claims to offer them. Moreover, as from the report of Mr. John S. Raworth, it appears to be questionable whether more than 2,000 H.P. will be available after making due allowances for losses in generation and distribution, it seems superfluous to talk of 10,000. However, Mr. Raworth considers the scheme perfectly practicable, and as he is the company's consulting engineer, who is to say him nay? But surely it is injudicious to allow such a statement in the prospectus as the following:—"The demand for electric power all the year round being largely in excess of what this company can supply there appears to be no doubt of the enterprise proving a most profitable one to the investor." However, as the subscription list closed yesterday, it is useless to further discuss the matter.

A Corner in Electrical Heating.

We are distinctly slow in this country. It is only after the incessant labour of electrical specialists that English people are beginning to realise the fact that electricity can actually perform cooking operations. Yet when one ponders on the manner in which Crompton, Binswanger, and Dowsing have wrought to establish the claims of electricity in culinary operations, we are afraid they have had but a poor return. We should not like to be compelled to eat all the chops that have been cooked by Mr. Dowsing in demonstrating the efficacy of electrical cookery, not that Mr. Dowsing's methods leave anything to be desired, or that the chops which have been immolated on the electrical griller would lessen our faith in English butchers. But in America they seem to have gone far beyond the exhibition stage; electrical cookery has apparently ceased to haunt scientific gatherings, and has settled down to real business, the latest news being that the absorption of all the important electric heating companies has been effected by the American Electric Heating Corporation. Whether this combination will ever reach the dimensions of the Standard Oil Trust and other colossal American organisations, it is difficult to say. Meanwhile, a greater use of electrical heating apparatus in this country is very much to be desired, for although we cannot go the lengths of the electrical enthusiast who maintained that the use of electrical shaving pots and hair curlers would flatten the load curve, it must be admitted that electrical heating might fill up a hole.

ON SECONDARY BATTERIES FOR ELECTRICAL LOCOMOTION.

By DESMOND G. FITZ-GERALD.

In a paper on "A Method of Electric Traction for Tramways in Towns,"* read by Mr. George Cawley, M.I.M.E., on June 28th of last year, the author said: "As regards accumulator cars, they would really constitute an ideal form of electrical tramway traction in towns if the present weight of 12 to 16 tons, and the power and traction expenses of 8d. to 10d. per car mile could be reduced to one-half."

Sixteen tons, or even 12 tons—to say nothing of 20½ *tonnes*, which has been given as the weight of some of the Paris tramcars, with passengers and accumulators—seems an enormously high figure for the weight of one of these vehicles. And the above passage seems to imply that the great weight is mainly or wholly due to the electrical system of traction. Certainly no car weighing, when empty, 11 or 14 *tonnes*, would have been constructed for horse traction. But there is no necessity for the construction of such ponderous vehicles for accumulator traction. Reckenzaun's (1885) accumulator car weighed only 2½ tons when empty, and carried 42 passengers, besides the guard and the conductor. His accumulator—cruelly overworked—weighed only 1¼ ton. Although in the heaviest Paris tramcars the accumulators weighed as much as 3 *tonnes*, this fact does not account for the great weight of the cars *en ordre de marche*. The truth is that certain advantages in regard to strength, durability, and convenience, were considered to be concomitants of weight. More recent *data*, it should be said, give the weight of the St. Denis-Madeleine and the Opera-St. Denis tramcars, to carry 50 passengers, as 10 to 11 tons; whilst the weight of the accumulators has been reduced to 1¾ ton. With passengers and accumulators, the maximum traction weight is about 13½ tons. No doubt this might, probably with advantage, be reduced; for in the United States, I believe, the cars, with passengers and two 15 H.P. motors, generally weigh about 9 tons. This weight, with the addition of accumulators, would not meet quite Mr. Cawley's first requirement; but, on the other hand, it must be remembered that additional weight may mean additional strength, and that the wear and repair of trucks constitute an important item in the cost of working a tram line.

In pointing out that the power and traction expenses per car mile should be reduced to 4d. or 5d., Mr. Cawley, no doubt, hit the right nail on the head. The *one and eight pence halfpenny* of the Birmingham Accumulator Tram Line is a standing discouragement in this country to the use of secondary batteries for locomotives either on rails or on the road. It reflects discredit upon inventors, makers, and users of these appliances that we cannot, apparently, except under an additional expenditure of 173 per cent., obtain the comparatively brilliant, but intrinsically very poor results, which have rendered traction by means of accumulators commercially practicable in Paris.

In that city—with, as we have seen, very heavy cars—the cost per car mile is 7½d. Of this sum, more than 1½d. is absorbed in the maintenance of, and attendance to, the accumulators. That this amount is excessive is sufficiently evident from the fact that the total cost of the motive power, exclusive of such maintenance and attendance, is but 1¾d. The explanation of the heavy expenditure for maintenance is, in my opinion, a very simple one; the accumulators, though an improvement upon some other forms, are yet not adapted to the requirements of electric locomotion. Little attempt has, in fact, been made hitherto to design an accumulator for the purpose in view. The weight of electrolyte, as will be seen further on, has almost invariably been far in excess of what is required; indeed, I cannot find that it has in any case been calculated in accordance with known scientific data, supplemented by those arrived at by experience. No serious endeavour has been made to arrest the denuding effect produced by the continuous washing of the plates by the electrolyte when violently agitated by the jolting vibration of the cars. This effect, which may be entirely obviated by a well devised *afluidic* system, is most detrimental in the case of what is now usually termed the *positive* plate of the accumulators, viz., that which is mainly composed of the most *electro-negative* conductor known to electricians. Here we have the principal and proximate cause of the essential failure of the accumulator which in France has given the most successful results hitherto obtained. The following extract from the report of the committee appointed in France to consider the various systems of traction by electricity, sufficiently indicates the weakest point, not only of the improved accumulators used by the Société des Tramways de Paris, but, with perhaps one or two exceptions, of all accumulators which have been put forward as being adapted for electrical locomotion:—

"The negative (spongy lead) plates of these (Laurent-Cely) accumulators have shown remarkable durability, having exceeded 93,210 car miles. The positive (peroxide) plates became, on the contrary, (much) more quickly deteriorated; the peroxide was rapidly shed, leaving an unserviceable grid support. In order to avoid this serious drawback, the Société pour le Travail électrique des métaux has since adopted for the 'positive' plate a new form of frame similar to the old Faure model; it is constituted of a non-perforated core, on which are cast slightly-inclined channels. These last maintain the peroxide in position for a longer period, and can afterwards be readily re-pasted."

It is scarcely necessary to read between the lines of the above extract in order to account for the large (although *comparatively* small) expenditure for maintenance and attendance.

If this difficulty had been overcome, there would, I think, have been no opening in Paris for the underground system of MM. Claret and Vuilleumier, which is now about to enter into competition with the accumulator system in the French capital. There, the overhead trolley system is absolutely prohibited.

Turning to the question of automotric carriages for ordinary roads, I am one of those who look forward with confidence to the adoption of an improved secondary battery as the motive power for the heavier class of vehicles. In regard to the lighter carriages, there is no denying that the admirable petroleum (benzine and kerosene) and steam motors which have lately been introduced, almost entirely occupy the field at the present time, and are likely to do so for some time to come. Indeed, amongst men to whom the tending of a small engine is a pleasant instead of a distasteful task, the petroleum motor will always be popular. But in the case of the large and usually wealthy class with whose ideas of perfect comfort and security steam or heated petroleum is incompatible, a light and *afluidic* accumulator, if it can be rendered practicable, in conjunction with an electric motor, will always be preferred. This is the view of M. Hospitalier, who says:—"In spite of the success of gasoline carriages, electrical carriages offer such advantages in point of comfort, convenience, simplicity and easy manipulation that we must continue to believe in their superiority for non-rural districts, in the case of large towns provided with a distributed supply of electrical energy." Not only in large towns, but, if I may venture to prophesy, in their suburbs and vicinity, there will, at no *very* distant date, be generating stations for the supply of electrical energy, partly in the form of charged accumulators.

Since 1889, when Mr. Radcliffe Ward constructed the first electrical omnibus, which was afterwards experimentally run in the crowded streets of London, the work in this direction has been continued by several young and more or less energetic men whose courage and industry has, so far, met with no better reward than that of the pioneer who was at least a little before his time. (I am old enough to remember George Francis Train when he came over from the States to initiate the construction of our suburban tramways; and I hope that our more modern initiators may not have to wait quite so long as he did for some recognition and success.) It is, I think, only the want of a secondary battery, suitably designed and constructed, that has, up to the present time, rendered these endeavours practically and financially unsuccessful. As in the case of the accumulators used by poor Reckenzaun in his tramcars, those used by Ward and some of his successors presented, after a few day's running, a most lamentable sight, both whilst standing in

* See Electrical Review, July 5th, 1895.

their trays amidst the acid-saturated sawdust, and afterwards when removed for examination and repair. Perhaps even now some of the workers in this direction do not quite appreciate the paramount and essential importance of the secondary battery in the practical solution of the problem in view. They are too anxious to "get the traps running," and overlook the necessity for ascertaining as a preliminary, by careful and long-continued experimental trial on a comparatively small scale, whether their accumulator will do the required work under conditions certainly not less favourable than those of actual practice. If it will *not*, how futile to go ahead! If it *will*, then there is a strong *primâ facie* case to justify the experiment on a large scale under the conditions of actual practice.

It might be well for some of the young and energetic workers if they had at hand an adviser who would duly insist upon the foregoing considerations. Let me illustrate, by a fragmentary dialogue, the character of the advice which, in one case at least, has been given, and which, in other cases also, might, perhaps, advantageously be given :—

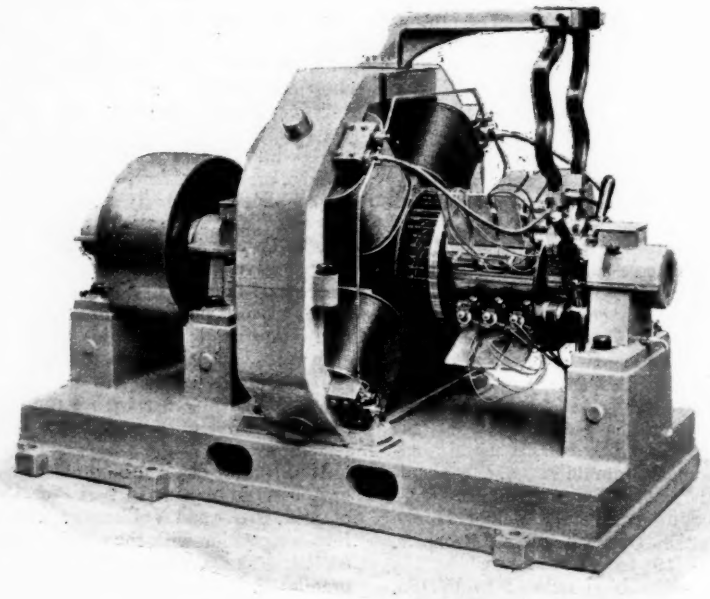


Fig. 1.—Some Recent Dynamos.

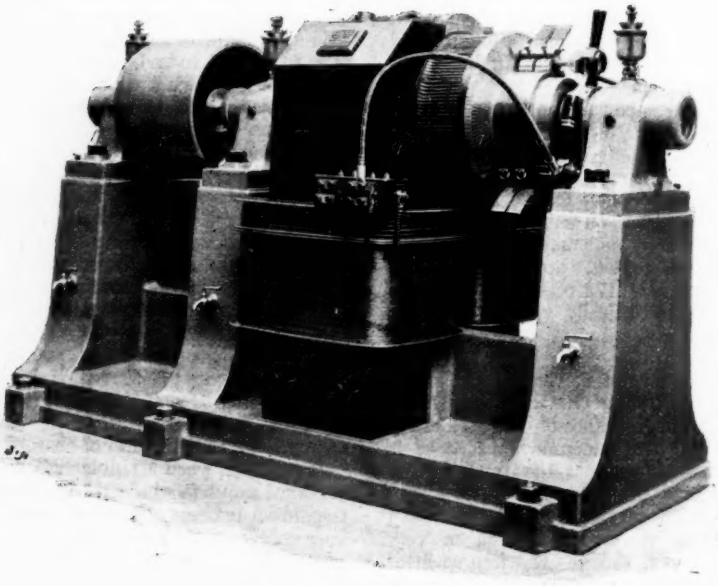


Fig 2.—Some Recent Dynamos.

1. Electro-Chemist: "Now, how about the *power* of your battery; the ratio of watts to gross weight in (say) pounds avoird.? The last time we met you did not quite see the importance of this datum; nor could you give me a verified mean value extending over a few successive charges and discharges."

Electro-Cyclist.—"Well, the accumulator I have tested weighs 335 lbs., and I find I can safely get out of it a mean power of 234 watts. This allows for occasional *coups de fouet*, during which the power is three or four times greater."

E.-Chemist: "Then your mean value for the ratio is ·7. You had better pull up short, for you are hopelessly out of the running."

2. E.-Cyclist: "With my 30-lb. cell, a safe rate of discharge is 20 amperes, and I can keep that up for over three hours. You can hardly, I think, better that."

E.-Chemist: "*You* will have to improve upon it, for you do not come up to what has been done, and you are under the necessity of doing somewhat better."

E.-Cyclist: "You say: 'What has been done;' you mean in the laboratory? But mine is, I think, a thoroughly practical result."

E.-Chemist: "I do *not* mean in the laboratory. A considerably better result has been obtained, week after week, and month after month, on a tramcar; and there is no doubt but that results far better than that can be obtained in practice. But what you have given, viz.: $\frac{\text{amperes}}{\text{lb.}} = \cdot 66$, is your *mean* rate of discharge. Can you increase it to something between 2 and 2·6 for short periods of time — whipping-up periods!"

E.-Cyclist: "No; I think what I have given is close upon the maximum rate."

E.-Chemist: "Then I should advise you to give up for the present the idea of running street cars."

3. E.-Chemist: "To use such a battery for traction would be simple imbecility. One of the elements is constructed to go to pieces, without any jolting, as soon as it is fairly well formed."

E.-Cyclist: "All peroxide elements, from what I can gather, are liable to go to pieces when fairly well formed."

E.-Chemist: "In the case of a properly designed element, that happens only when the whole of the lead—or very nearly the whole—has been converted into peroxide. But, now, look at this plate; it is ready to break into two halves, along a line of least resistance. There! it has parted. You can see very little metal — only peroxide. But, now, take this saw and cut into the plate. Now, you see very little peroxide—only metal. If this metal had been in the right place, instead of being useless dead weight, the element would have remained serviceable for a long time."

4. E.-Cyclist: "Given an accumulator that will stand jolting to any extent (and that, I think, we have), the question is merely one of weight of accumulator per ton of traction weight. Now, Reckenzaun used to allow from 5 cwts. to 5·7 cwts. per ton; and, under the same conditions,

4 cwts. of our accumulator would certainly suffice. I fancy we have a 'pull' there!"

E.-Chemist: You will have to pull something off the weight of your battery. In 1885, Reckenzaun used only 386 lbs. of accumulator to the ton of traction weight; although he afterwards increased the ratio with a view to augment the durability of his accumulator. But, within the last few years, the ratio, in actual and continuous work, has been diminished to 322 lbs. per ton of traction weight (on rails). *That* is what you have to beat, and to beat by "long chalks," if you want to show a success that will not speedily be eclipsed.

(To be continued.)

SOME RECENT DYNAMOS.

We give below a description of some dynamos recently constructed by Messrs. Paterson & Cooper.

Fig. 1 shows the four-pole type of dynamo constructed by them for use with the Hermite system of sewage treatment. Machines of this design have been supplied to the Ipswich Corporation and to the War Office for their hospital at Netley. Fig. 1 is from a photograph of the machine supplied to the War Office. Its output is 600 amperes, 15 volts at 500 revolutions per minute.

The armature, which is 12½ inches diameter, is a drum with Glover's patent bars connected in two parallels, and there are four sets of brushes. There are 88 armature conductors of square section ·3 × ·3 and the resistance of the armature is ·001.

The magnets and yoke are of cast steel, the section of the cores being 5 inches by 7½ inches. They are shunt wound, each coil having 386 turns of wire ·18 diameter. The resistance of the shunt circuit is ·3375 ohms.

As these machines have to make very long runs and are frequently overloaded for considerable periods, they have

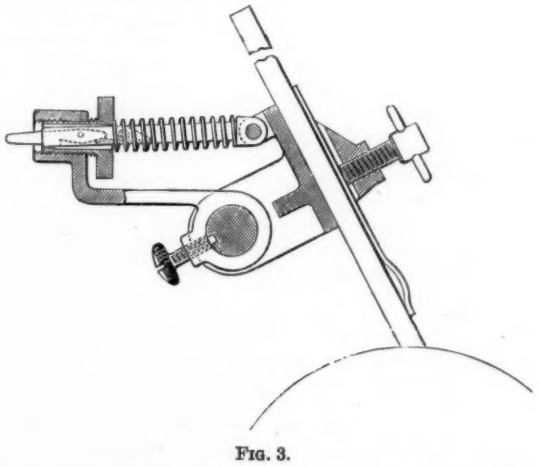


Fig. 3.

been designed with a large margin both as regards sparking and heating. The Netley machine after a five hours' run at full load had the following rise of temperature:—

Armature, 15 degrees Centigrade.
Magnets, 14 " "

It has been run with a load as high as 900 amperes without sparking and without undue heating. It is fitted with self-oiling bearings.

Fig. 2 is from a photograph of one of a pair of 60 arc light dynamos, made recently for the Barry Railway Company. The output of the machine is 600 volts, 75 amperes at 675 revolutions per minute. It is compound wound and is intended to supply a current to five circuits, in each of which there are 12 arc lamps, taking 15 amperes.

The armature is a Gramme ring, 16½ inches diameter by 14 inches long, and is wound with 560 turns of laminated strip having a section of ·15 × ·2. The resistance is ·1450. The magnet limbs are of wrought-iron 9¾ inches diameter by 14 inches. The shunt winding consists of 8,836 turns of wire ·038 diameter. The resistance of the shunt circuit is 635·8 ohms. The shunt winding is put on in such a manner as to bring both ends on the outside, as with such fine wire an inside end would be very liable to get broken and so cause considerable trouble. The series winding consists of 30 turns of 19/14 cable, the resistance is ·0225 ohms. The electrical efficiency of the machine is 97 per cent.

Owing to the high voltage across the shunt coil the series winding is placed on a separate former.

The total weight of the machine is about 3¾ tons.

A sectional drawing of the type of brush holder fitted to these machines is given in fig. 3.

The brush holder is held to the spindle by a thumb screw, the point of which fits into a key-way cut along the whole length of the spindle. By slacking the thumb-screw the brush holder may be slid along the spindle from time to time so as to avoid grooving the commutator.

A screw adjustment is provided for varying the strength of the brush holder spring, and a spring trigger is fitted to hold the brush off the commutator when the machine is not running.

The machines are the design of Mr. C. W. Hill, manager to Messrs. Paterson & Cooper.

HOW TO INSTAL AN ELECTRIC MOTOR FOR BLOWING CHURCH ORGANS.*

By S. H. Sharpstein.

The manufacturer of electric motors, and the people installing them, are quite frequently called upon to place small motors for blowing organs in churches, halls, houses, &c. After some consideration and figuring, the electrician or engineer finds that there are some problems about such plants that are not so very easily solved. A person conversant with the business will become thoroughly surprised at times to see what amateurs contrive in the way of belts, shafting, pulleys of all sizes and rheostats, in order to try and pump an organ by electric motor.

When the problem of what apparatus to use and what methods to adopt to get the best results for the least money is left for the engineer, if he has got to choose between water from the street mains and a 220 or 500 volt power circuit, usually finds it no easy one to solve. In a case where a very low flat rate can be made for water, the rate to be assured for a number of years, the question is quite easily answered; but, when the water has to be paid for by meter, such power is very expensive as a rule. The piston water motor, when properly installed, works admirably. Year by year sees water motors taken out and electric motors put in, as water companies insist on meters, and as the quality of the water is improved and the supply becomes scarce, as the towns and cities grow, the water rates go up as a rule. When electric power can be gotten by meter at a reasonable price per 1,000 watt hours, water by meter cannot compete. The electric motor being decided upon, then comes the question of efficiency, fire hazard, noise, durability, price, and compactness. Everything must be made automatic, so as to need no attention for weeks at a time.

When the engineer considers some of the so-called perfect methods of pumping organs by electricity, and follows the path along which the power has to be transmitted, leading him through mammoth choking coils, shafting, and some belts travelling only 40 or 50 feet per minute at times, and he comes out with a net efficiency of only half of 1 per cent., he is filled with wonder at the perfection of the scheme. The matter of methods for a higher efficiency we will consider later.

The question of fire hazard is a vital one, since all about the motor, if placed in the room with the organ and bellows, are materials that will burn readily if once a fire is started; but if properly installed, there is no danger from fire with an electric motor, even though it be in the room with the organ. It is quite a common thing to put the motor in a basement, and let the pitman that operates the feeder bar extend down through the floor.

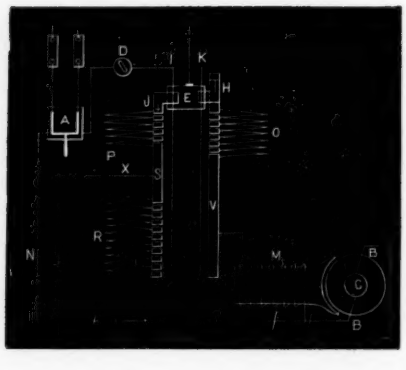
It is surprising to find how a small noise made by a motor will be amplified so as to be heard all over a hall or church. The writer has in mind a motor plant that was placed under a large church to blow a large organ. Four pieces of timber had been framed into the floor timbers directly under the organ, and projected down to a good masonry foundation.

* New York *Electrical Engineer*.

Upon these four sticks a good, substantial platform was built, about 5 feet from the ground, upon which the motor was placed. The motor was about 3 horse-power, and never made more than 1,200 turns per minute. When started up, the hum of the iron in the armature could be heard all over the church. The armature was toothed, or iron clad.

Although the commutator was very smooth, it was thought at first that the hum came from the brushes; but on changing to light copper brushes, there was no difference that we could perceive. The organ builder then placed a piece of rubber packing, about ¼-inch thick, under the motor. Still there was most of the noise. There was a perceptible noise from the pitman, shafting and belts, that could be heard in the audience room of the church, and could not be heard in the basement. The audience room floor was a mammoth sounding board, which carried the vibrations to every pew, and up them to every portion of the room. It was thoroughly demonstrated then that all the trappings connected with the pumping machinery should be placed upon something independent of the audience room floor.

A very short time after placing the motor mentioned above, the writer placed another in a pipe organ just back of the front pipes. The front of the organ was in a hall that was very high; the back of the organ was against a portion of the building that had two floors to the hall's one. Almost all of the organ was placed in the second story, which came part way up the length of the large pipes in the front of the organ. The motor stood on this second floor, about 6 feet back of the front pipes. This floor, upon which the motor stood, made a good sounding board, and the least noise could be heard in the hall. The commutator of the motor was



greased, so that the brushes did not make any noise. The armature did not hum but a very little, as the machine was small; but a very little irregularity of the belt could be heard, as it would strike the pulleys. It was necessary to take the motor out of the organ and place it in a back room; even now the least noise that the pitman may make can be heard very distinctly in the hall.

The question of durability is of vital importance. When once turned over to the purchasers, the motor is not apt to get much care, unless some good organ builder has charge of the organ. The bearings of the motor ought to be self-oiling, and the oil reservoirs ought to be large, so as to hold quite a quantity of oil. The brushes should be carbon, so as not to cut the commutator when not oiled or lubricated otherwise.

Method of Controlling Organ Blowing Motors.

One source of great depreciation with some equipments for pumping organs has been the metal points, over which the contact piece keeps moving as the resistance in the rheostat is cut in and out by the bellows working up and down. At first thought it is realised that the speed at which the motor is to work at any one time is determined by the amount of wind the organ is using. When using the wind faster than the feeders are supplying it, the bellows will drop down, and this lowering, together with the rising of the bellows, enables the engineer to get a point to start from in the regulation of the motor. The method of regulation that has been so much used has been a weight lying on top of the organ bellows. To this weight a string is attached, running to a lever, or directly to the arm on the resistance box. As the bellows lower, when a sudden demand is made for wind, the weight goes down with the bellows, and pulls the lever on the resistance box in such a way as to cut resistance out of the armature circuit, which will have a tendency to make the motor run faster, and hence work the feeders faster to keep up with the demands of the performer at the keys. When less wind is used, or the feeders commence sending too much wind into the bellows, the bellows rise up, and by means of the string, lever, &c., cut the resistance in and slow up the motor. At the time the bellows get full, there is so much resistance in circuit with the armature that the motor stops, or very nearly so, depending on what is being done at the keys, or whether the organ is leaky or not, which would determine the bellows staying full for any length of time.

To the beginner, this method seems all that could be desired, so he sets to work and makes a box with ample resistance in it to choke down the motor, and puts about 10 points on the face of the rheostat for movable contacts to pass over, and puts the same close to the organ, and gets it connected up. After some adjusting of lever and weight (right here we might say that a weight is used instead of putting a screw eye in the bellows to prevent pulling anything to pieces in case some lever or string might get fast, and not want to move as the bellows go down, and many times it is not necessary to have the weight travel as far as the bellows) the thing is got working in pretty fair shape, and all seems to be going on nicely; but the electrician in charge notices a small spark as the movable contact passes up and down over the fixed points.

Next day he comes to see how the thing is working, and understands that the motor is doing all right, and the equipment has had a good test, since the builders have been very busy tuning ever since the thing was started. This sounds like good news, but as the electrician gets around and looks at the controller or resistance box, there seems to come a sort of serious look over his face. Even when there is nobody at the keys the bellows keep moving up and down some, and this moving of the bellows keeps the contact points on the rheostats sawing. As the movable piece leaves the stationary points, the thing sparks four times as much as it did the day before. This is serious, the spark becoming so large that the people about the organ notice it, and seem to be fearful that it will set something on fire.

After trying one thing and another, out comes the box, and about 70 or 80 stationary points go in the switch, and this makes the difference of potential so small between the bars, that the sparking is stopped, and all seems to go on well. The builders get the instrument tuned, and then come the efforts of organists to empty the bellows with full organ; but the man who installed the motor is not afraid of that, since the motor is amply large, and can do the work without any trouble. But the right man happens to get down at the organ, and he plays along with most of the stops in for a time, and uses so small an amount of wind, that the motor and shafting is almost stopped. All at once he pulls out more stops, and seems to make an effort to get down all the keys on the board; the music would have been grand, but before motor and gearing, together with the feeders, get started, the bellows are empty, and one great funny noise is made by the organ, that tells the story of an empty bellows and some hustling feeders. The bellows had gone away down, the resistance was cut away out, and about the time that the bellows get empty, the motor starts out on the emergency trot, and the feeders punch the wind into the bellows so fast, that the top of the bellows reminds one of the surface of the sea.

This thing is quite apt to occur, especially if the bellows are a little small for the organ, and will not hold wind enough to supply the full organ for a short time. This method of regulation is not what it ought to be, for several reasons. Someone will say that he obviated the trouble just mentioned by having the resistance cut out very rapidly as the bellows start down; but if the rheostat is manipulated by hand, and all cut out at once, it takes little time to get things started, if lots of shafting and pulleys are used, and by the time things are under way, the bellows are empty.

Compactness is the last point we consider, but is by no means one that wants little attention. Architects seem to think that an organ can be squeezed into almost any kind of a corner, and as a rule, the electric motor and its accessories have got to be put in a very small place.

We often see a motor installed to drive an organ when the

motor is belted to a counter-shaft with one very large pulley and another one very small in diameter. From the pulley motor the belt runs onto the large pulley, and this first belt has a proper speed. From the small pulley on the counter the second belt runs on to a pulley on the shaft that contains the crank that works the pitman. Since the speed of the pitman shaft is so slow, sometimes not over 20 turns per minute, it stands to reason that this second belt must have a very slow speed, even though there is a large pulley on the pitman shaft to have it run over. This arrangement is very cumbersome; it takes up much room, and is bad in many respects, although so often used.

The writer has found the following arrangement compact and durable: On the shaft of the motor in place of a pulley put a worm to work into a gear, the worm and gear proportioned properly, so that the shaft with the gear will make the proper number of revolutions for the crank and pitman. The inverted hangers to be used for supporting the crank shaft would be best if self-oiling, although the speed is so slow that very little lubricant is necessary if the bearings are large enough and made of good babbitt. The hangers will straddle the pulley end of the motor, and if the motor and hangers are placed on a slate slab about 2 inches thick, the whole arrangement is compact and complete. If the motor is to be placed where there must be the minimum of noise, the worm and gear will probably have to be cased; but if not, there is no reason why it will not run very nicely open or uncased.

An oil cup can be arranged, so that when the motor is working, a lever worked by the magnetism of the fields will turn the oil on when the motor starts, so as to keep the gear oiled. If the equipment is to get but very little care, a small pan under the worm will hold oil and lubricate the thing very nicely. There should be a drip pan under the worm and gear anyhow, even if a cup is used. It is the work of a mechanic to get motor and bearings so arranged on the slab of slate that the whole thing will be stiff, and work without noise. When compared with some of the old methods, it will surprise a person to see how little space the whole thing, ready for the pitman, will take.

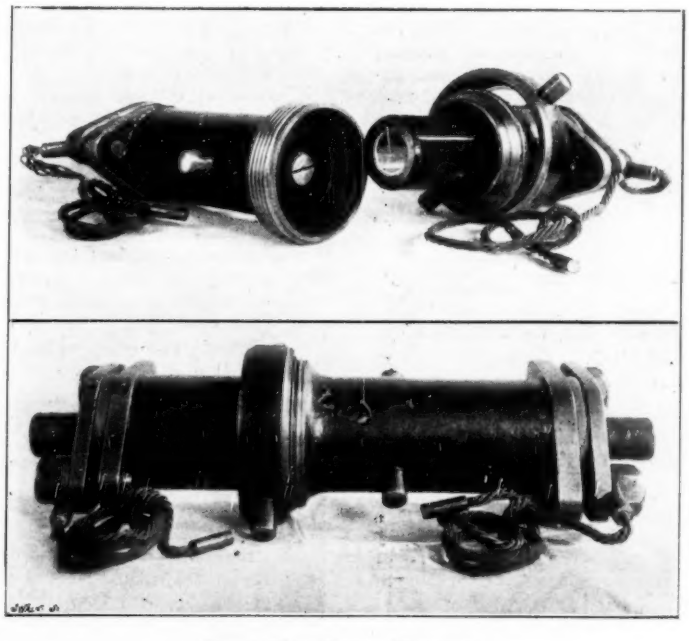
The question of end thrust will come up at once, and seem, to some, to be quite a serious question, too; but if the end of the motor bearing next to the worm is well finished, a vulcanised fibre washer put between worm and bearing, and the worm left on a feather so as to move lengthwise on the shaft, the arrangement will be found to work nicely if the motor bearing is stiff, as it should be, on the pulley end. Persons not conversant with this work must bear in mind that the whole thing must be made solid and securely fastened to the floor, or something similar, or it will hammer and chuck as the crank gets its up and down thrust.

The electrical part of the plant we will try to explain by the use of the accompanying diagram of circuits.

A is a double pole knife switch that should be in a convenient place, and opened every time the organ is done with. This cuts the current off from the apparatus in all respects, which is demanded by the fire underwriters, and makes it very convenient when working around the motor.

From the right side of the switch one leg of the circuit leaves, and at D we will consider that we have placed a snap switch of either 500 or 220 volts, as the case may require. This switch must be on the front of the organ, where the organist can reach it with ease, and should be placed on a piece of slate to make it secure against fire. From this switch the circuit is run up and connected to brass bar, I. On the two brass bars, I and K, runs a moderately heavy weight; cheap babbitt makes a good one. On to this weight are fastened two brushes that travel on the compact columns, S and V.

When the organist is down at the organ and the switch, A, is closed by turning the switch, D, current passes into the metal weight, E, and from there into brush, H, thence down the segment bar, V, through the resistance, O, into the field of the motor, M, and back to the switch. This excites the fields of the motor ready for a start; at the same time the current passes into the other brush, F, through the resistance, P, and thence through wire, X, around through the armature and back to the main switch, A, through the wire, N. The resistance, P, acts as a starting box for the motor, and as soon as the brush, F, passes down over the blocks, starts the motor nice and easy, and as soon as the brush, F, gets over this first lot of points, the motor and organ feeders ought to have a speed that will furnish more wind than the organ can ever use, allowing quite a margin for leaks in the organ, which are sure to come sooner or later.



Penson High-Tension Coupling.

The organ builder is supposed to be able to tell the number of times per minute the feeders have got to be emptied to supply the organ with wind, but their estimates do not always hit the mark. The travel of the feeders, their size in square inches, together with the pressure per square inch inside the bellows, will give the data that a person has got to work from, to determine the amount of work to be done. Sometimes the feeders are wedge shaped, and work like a cover on a book; this adds to the complication of the matter; but with the help of a good organ builder, a person can soon estimate the work to be done at the pitman.

To get back to our motor. The weight on the organ bellows, attached to regulation wire or cord, ought to be so arranged, that soon after the brush, F, gets the resistance, P, cut out, the bellows should be three-fourths full, or this should take place before the brush, H, commences to cut out the resistance, O. The resistance, O, ought to regulate the motor for all the ordinary work of the organ. This resistance changes the current flowing through the fields, and makes the regulation very decided. If the motor is a 2-horse-power machine, it will always do 2-horse-power work while being regulated through this resistance, and will respond very quickly as the resistance is cut in or out.

People who have always worked with a resistance in the armature circuit for regulation, will be surprised to see how quickly this arrangement will respond to any change in position of bellows, so much different from the sluggish action

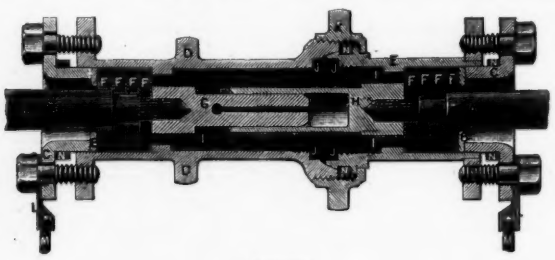
of the motor with resistance in the armature circuit. And again, the amount of current passing through the field wires should be very small, hence high efficiency, and no cutting from spark with a few points in the rheostat.

With the controlling resistance in the armature circuit, more than double the energy is lost at times in the rheostat than is used in the motor. Some one who has been trying to build a slow speed, high efficiency motor by putting almost all the wire of the whole machine on the armature, may say that the arrangement will not work; but a trial will tell the story. The people above mentioned will say that the motor will spark excessively with a weak field, but such is not necessarily the case. If the quantity of iron and wire are kept down in the armature, and the fields properly wound, the arrangement works very nicely. The motor has got to be quite slow speed for a small one, but this can be arranged for by using a larger frame than is customary for the size of motor wanted. The resistance, R, will come in use when the organist has stopped playing for a short time, for tuning, &c., if the organ is in good condition and does not leak much. Switch F cuts this resistance into the circuit with the armature when the bellows get full to the extreme capacity; it ought to stop the motor still if necessary.

It is very covenient to have the starting coils in the iron box with the other coils, but the organist must understand never to commence to play a piece of music that will take much wind until the bellows get time to fill. With the average organ all the resistance wire except the starting coils can be very fine. Since so little current is manipulated in controlling the arrangement there is not much heat to be gotten rid of, hence all can be placed in a small iron box properly ventilated, and an iron cover put on. This should suit the most exacting of the examiners for the board of fire underwriters. A piece of slate should be placed between the controlling box and the floor, or any support that the box may be fastened to.

PENSON'S PATENT HIGH TENSION CABLE COUPLING.

This coupling, which we have recently had the pleasure of examining, is designed to combine high insulation with simplicity and strong mechanical construction. It is also



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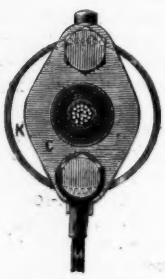
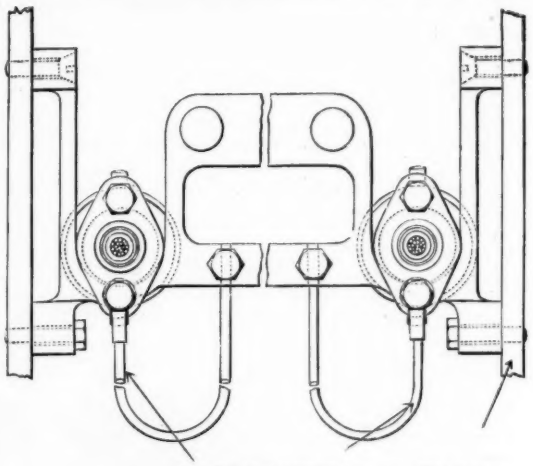


End Elevation.

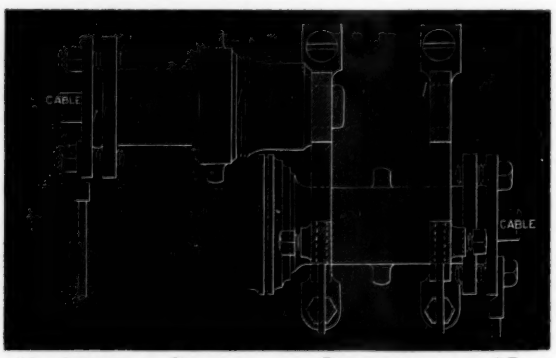
claimed that it is quickly and easily fixed, and, what is of considerable importance, the outer metallic case being connected to earth, there is comparatively little danger in handling. The specimen, of which we give an illustration, bears evidence of being carefully designed, and certainly strikes one as being mechanical.

Referring to the sectional drawing, the outer casings, D and E, are made of gun-metal, and the parts in which the terminals, G and H rest, are lined with porcelain or ebonite, I, which is firmly secured by the fibre nuts, J, J. The two halves of the coupling are held together by the nut, K, which also forces the ground cone into its seating, thus making a water-tight joint. This joint is also further secured by the rubber washer, N, which takes its seating before the ground cone is quite home. The terminals, G and H, are withdrawn to solder in the cables, A, A, the glands, C, and the rubber and brass washers, F, F, and B, being first slipped over. After the cables have been soldered into the terminals, they are replaced



Elevation of Couplings in Road.

in their original positions and the rubber washers, F, F, are made to grip the cables, A, A, by tightening up the glands, C, C, and so making perfectly water-tight joints, and, at the same time, fixing the terminals, G and H, in their places. The joints between the stuffing boxes and glands are also further secured by the rubber rings, N, N. Under the head



Arrangement of Couplings when Disconnected, the "Live Ends" being Insulated with Ebonite Caps.

of one of the gland screws, at each end of the coupling, a terminal, L, is fixed, into which the flexible earth connection, M, is soldered. The couplings are carried in the pavement or road boxes by cast-iron supports fixed across the boxes, the flexible earth connections being connected to terminals provided for this purpose on the supports. To prevent the possibility of a cross connection, one coupling is coloured red and the other black. Ebonite caps and nozzles are provided for protecting the "live" ends when the coupling is disconnected, which are readily attached.

THE "UNIVERSAL" ENGINE.

The long-expected engine which was mentioned in the annual report of the Brush Company in September has at last made its appearance. That there is plenty of room for it cannot be doubted, as it has become evident of late that in

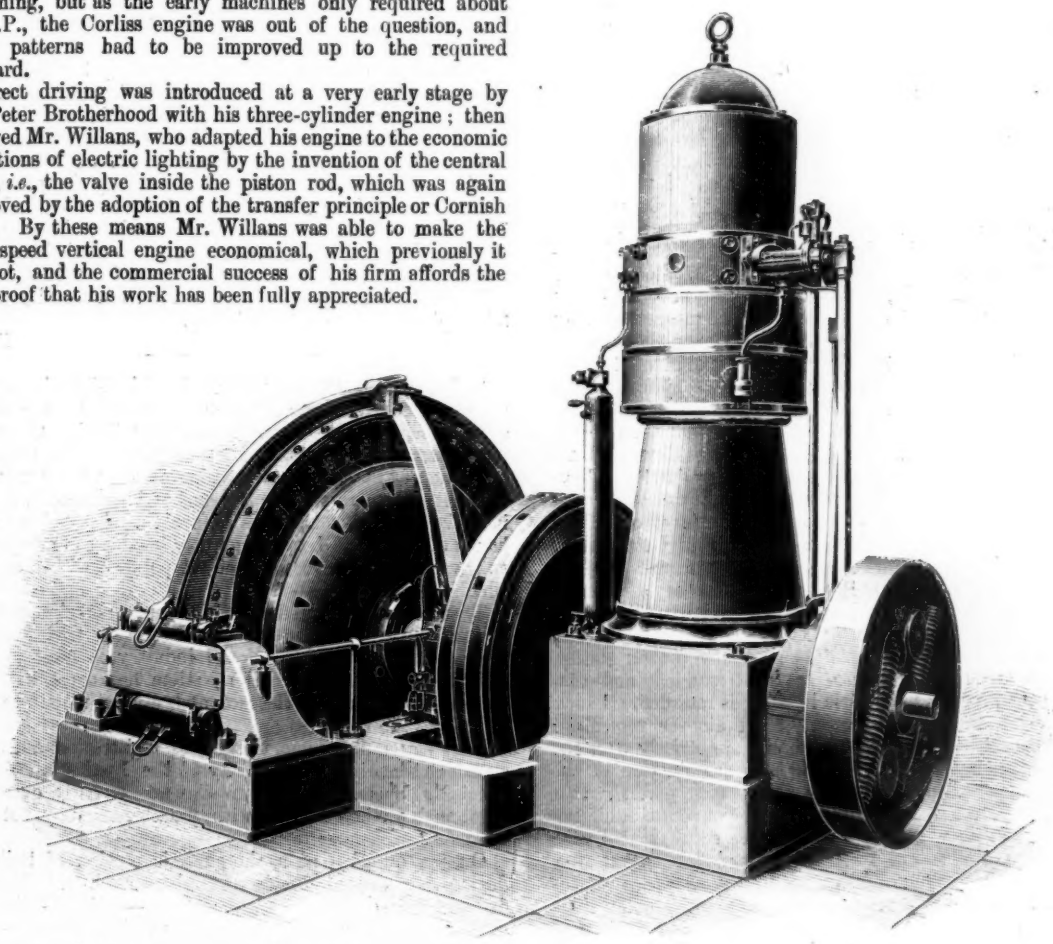
electrical engineering "Willans" and "Corliss" have been drifting towards a division of the field between them. As in all matters of controversy, however many schools of thought there may be at the commencement, they usually settle down to within a decade, and then the battle begins in earnest and victory to one side or the other soon follows.

The "Corliss engine" came to this country from America, and quietly shouldered out all competitors to such an extent that it now enjoys the field to itself for cotton mill driving and similar works. The reasons of this success are that at the date of its advent there was no expansion gear known that could be controlled directly by the governor with anything approaching the ease and accuracy of the Corliss.

In cotton spinning economy is desirable, and good governing is essential. No wonder, therefore, that a practical combination of these two good things was rapidly taken up by mill owners.

When electric lighting by means of the Gramme or Siemens dynamo came on the scene, it also required good governing, but as the early machines only required about 10 H.P., the Corliss engine was out of the question, and other patterns had to be improved up to the required standard.

Direct driving was introduced at a very early stage by Mr. Peter Brotherhood with his three-cylinder engine; then followed Mr. Willans, who adapted his engine to the economic conditions of electric lighting by the invention of the central valve, *i.e.*, the valve inside the piston rod, which was again improved by the adoption of the transfer principle or Cornish cycle. By these means Mr. Willans was able to make the high speed vertical engine economical, which previously it was not, and the commercial success of his firm affords the best proof that his work has been fully appreciated.



Mr. Raworth, the inventor of the "Universal" engine, has been working on the same problem for 16 years, and claims to have produced for electric lighting purposes more engine power than any engineer in this country excepting Willans.

The "Universal" engine is the outcome of constant endeavour to get higher speeds combined with economy. It is well known that the ordinary vertical engine cannot have its length of stroke reduced indefinitely without serious loss of economy in steam consumption, owing to the ever increasing rate of exposed surface to cylinder volume and corresponding losses in ports and passages. As mentioned above, these defects have been overcome by Willans, but only by the use of two cranks. The "Universal" engine has only one crank, and its mechanical arrangement is essentially simple. The most prominent feature of the arrangement is the shortness of the ports, which are entirely included in the valve box; the cylinders are, therefore, plain pipe castings. Then the design of the valve gear is such that the main crank shaft bearings may be of any length without introducing complicated guides or rocking shafts for transmitting the motion of the eccentrics to the valves.

Reference to the drawings shows that the steam enters the left-hand valve box, and is admitted to the under side of the high pressure piston by a Corliss valve controlled by the automatic shaft governor. When the piston arrives at the top of its stroke, the right-hand valve opens to the low pressure cylinder, the piston of which is forced downward until it passes the drain holes in the lower part of the cylinder. The action of the receiver is practically the same as in an ordinary compound engine, but the passages by which it is put in communication with the cylinders are not very clearly shown in the drawings, as they do not fall on the centre line, being, in fact, contained in those parts of the valve box which are before and behind the central gland.

The double-acting effect renders two cranks unnecessary, except in triple expansion engines, at the same time it introduces the possibility of knocking in the connecting rod joints. This tendency is, however, easily checked by the special construction of the connecting rod, which permits both joints to be tightened up quickly and simultaneously by means of a very strong screw adjustment in the central strut. Tendency to wear in the joints is provided against by making the crank pin and crosshead pin abnormally large; for this purpose, and to stiffen the shaft between the bearings, the crank pin is made 25 per cent. larger in diameter than the main bearings.

The governor is not new, but has been made and supplied in large numbers by the Brush Company for electric lighting purposes. The use of the Corliss valve, in connection with this governor, is found to give improved results, as will be gathered from the fact that, with a speed of 300 at full load, the speed with no load is only 303, and even with this fine adjustment there is no hunting.

The "Universal" engine can be fitted with reversing gear when desired.

D

CORRESPONDENCE.

The Wiring Question.

There is but little of general interest to reply to in the two letters which appeared in your issue of the 28th ult. It is pleasant to learn that there is such a demand, not only in London but in the provinces, for London union wiremen; long may it continue, for the common cry is that wiremen cannot earn a "living wage." Admitting that there are more non-union than union men out of employment at present, what are the proportions? How many electricians, wiremen, and carpenter-wiremen, are there in London, and how many of these are members of the union? Will either of your correspondents give the figures? It is possible that I may not possess the qualifications necessary to obtain admission to the union, but I have not received in London less than 9d. per hour, and have been in charge of more than one installation. What are the advantages offered by the union? Is an allowance granted to members out of employment? If not, why should a man refuse 7½d. or 8d. per hour when 9d. cannot be got, and walk the streets with a starving wife and family at home? It is simply a case of supply and demand; if he will not work for 8d. another will. I did not assert that all union men were incompetent, but I do assert that all non-union men are not incompetent, and that several of them have done the same work as is claimed to have been done by union men. I repeat that some of the electrical work can be done by men of other trades. Classes, books, technical papers, are as open to them as to wiremen, and with observation and practice an intelligent artisan can at least do three-fourths of the work. I have met wiremen who called themselves electricians, who knew less of the theories of electricity and magnetism than many mechanics. Where have the majority of the wiremen gained their knowledge? Where did they graduate? But what has the average wireman to do? Make joints, fit up switches, ceiling roses, &c.

It is the engineer or foreman who plans and lays out the work, not the wiremen. *En passant*, what qualifications are requisite to enable one to call himself electrician? I have met carpenter-wiremen and wiremen who styled themselves "electricians" whose knowledge of the theories of electricity and magnetism were of the most limited and elementary character. The registration of qualified workmen by the Institution of Electrical Engineers would be a boon to contractors and honest workmen, and would also tend to put an end to the abuse of the title "Electrician." It is admitted on all sides that the complaints made by central station engineers and their customers are well founded, and that thereby the progress of electric lighting is retarded. I have tried to state some of the causes. What are the remedies? Should consulting engineers not look more strictly after the work whilst it is in progress? An examination of the tenders published in the Review shows such diversity that one is forced to the conclusion that some of those tendering either do not know their business, or are so infatuated with the insane desire to cut their neighbours' throats that they do not care how much money they lose if they can get the contract. A case was brought under my notice some little time ago which is suggestive. Three firms were invited to tender for an installation. A. asked one sum, B. slightly less, C. less than half. The last tender was accepted, and the work started. All went well for a few days, until the consulting engineer called to inspect the work done. He had the capping removed at several points, and finally insisted, despite the contractor's explanations and tears, on the whole being removed, and the work done in accordance with his specification. That consulting engineer did his duty to his clients, to his profession, and to the workmen on the job. Had the work been gone on with without check, by 1897 the I.E.E. would have been favoured with a view of bad workmanship, followed by the usual cries of "incompetent men," "the scum of other trades," &c. Now, in this instance, the men who did the "scamped" work, so that their employer should lose the smallest possible amount of money, were able to do, and did do, ultimately, the work in a very satisfactory and workmanlike manner. Which was to blame? the workmen, or the contractor for undertaking work at a figure which could not pay?

Contractors could help by insisting on good and suitable fittings, and on conductors of the proper sectional area. How many contractors examine and use the micrometer on the wire they receive from the manufacturers? The diameter of the conductor and the insulation are accepted without the least suspicion as to their non-compliance with the catalogued specifications. Why should manufacturers be permitted to supply wire two mils. smaller than the sizes given in their lists? Prof. Ayrton, in the course of his remarks on the concentric and conduit systems, referred to the importance of the *economic* gauge, and, when his references are taken in connection with the above, this point will doubtless receive the consideration it deserves. Mr. Boot was, I think, unfortunate in his remarks. Labour *is* a heavier item than materials in an electrical installation, but it is not the same in a gas installation! When his "ironmonger of repute" instals gas, is it the cost of the piping that is the heavier item in his bill? Supposing we had a system "so simple that any intelligent man could put up an installation," surely even Mr. Boot would not object to pay his "intelligent man" for his labour, just as his "ironmonger of repute" pays his man. Why should the sauce given to the gasfitter not be given to the electrical fitter?

Contractors could further assist by obtaining their workmen from the registered lists of the I.E.E., paying a reasonable wage, according to the class of work, and insisting on thorough workmanship. Very soon but few contractors for the doubtful economy of 1d. an hour would employ non-registered men. It is assuredly cheaper to pay a good man 9d. per hour than an indifferent or bad man 7½d., for the latter will not do as much work, or as good work, as the former. If there was not a good demand for so-called "cheap" labour, the supply would not be so large.

Workmen could help by doing honest work, and giving a fair day's work for a fair day's pay.

Mac.

Owing to the exigency of getting Mr. Mavor's personal reply on the 13th ult., I was prevented by the abrupt adjournment of the discussion on the "Wiring Question" in making the remarks I had intended, and being unable to be present at the adjourned meeting on the 27th, I have had to send my remarks to the *Journal* of the Institution. As it is likely to be some time before the *Journal* is in the hands of members, I trust you may be able to find room in your valuable paper for some of the points I wished to raise, which are as follows:—

There can be no question as to the adverse circumstances created by the rush of inexperienced men and tradesmen into the industry. The whole of the industry is most prejudicially affected thereby; and the time has come when the Institution should face the fact, and use its power to curb and direct the future.

Why not employ some method of registration, and grant certificates bearing the authority of the Institution of Electrical Engineers, to the men who are properly qualified? Some such method obtains with plumbers. Why not with wiremen?

On the question of a thorough inspection of buildings during the fixing of the electric light wires by a fully qualified and independent electrical engineer—which is the only way to prevent undue competition and shoddy work—there are two parties concerned, viz., the *supply authorities* and the *insurance companies*.

Now, it is quite unreasonable to expect the hard-worked central station engineer to undertake the duties, with his hands already full, and without monetary compensation. Moreover, should this additional burden be put upon them, their position would be intolerable, as members of a corporation in the provinces are oftentimes the very men who wish to embark upon electric light wiring (coupled to their own business), and a disagreeable situation for the central station engineer might reasonably be anticipated.

I also very much doubt whether the insurance companies will come forward with properly qualified electrical engineers for each centre of supply, as has been suggested.

I would venture to suggest that some compromise might be made by appointing qualified engineers for large towns or districts upon the basis which holds under the Building Act, viz., the office of district surveyors, whose qualifications for the appointment are first attested by the Royal Institute of British Architects.

The Institution of Electrical Engineers might certify qualified engineers for district surveyorships, and be in touch with the local authorities. The local authorities, or County Council, in a large town or district, respectively to appoint such independent and qualified electrical surveyor to act for it.

Upon the creation of such an office, it is not improbable that the insurance companies might wish to avail themselves of the services of the gentleman holding such appointment to act as their local representatives.

If the Institution took the steps foreshadowed, and would bring to the knowledge of local authorities the Institution's "standard of wiring," suggesting a way of getting the rules carried out as indicated above, much of the discontent in the industry would, I fancy, disappear, and we, as members of the Institution, would remain proud of our officers, and glad of our corporate existence.

W. Howard Tasker.

March 11th, 1896.

I must ask you to allow me to deny the statements made by "Floreat Electra," as I maintain them to be a mean and contemptible misrepresentation of facts, set forth to bring discredit on the E.T.U.

In the first place he speaks of 40 members, of which there were only 10 who could be termed competent, or fairly so.

Now, as a matter of fact, these men, before being admitted, have to fill in and sign a proposition form, giving full detail of the work engaged on, rate of pay, rate paid in shop, how long at the trade, how long having been engaged in the shop at present working, &c., and it is not for "Floreat Electra" to say to the employers of these men that they are employing incompetent men, when they have to pay them the standard rate of pay. Again, how is it possible for the officials of the E.T.U. to refuse the admission of these men, when they are in receipt of Union rate of pay, and are giving entire satisfaction to their employers, by declaring them to be incompetent?

Re the benefits of the E.T.U. being stopped by the officials. This is most absurd; for if "Floreat Electra" knows anything of trade unions, the officials have not the power to do so.

The true facts of the case are these: the E.T.U. (and not the only Union, by the way) found their expenditure had exceeded their income through endeavouring to make too large a stride to improve the working conditions of their members, which naturally will, and does always, incur large expenditure.

This, then, required adjusting, and to make both ends meet, expenditure of general office and branches were cut down; and the E.T.U. being straightforward, and wishing to pay their debts, asked the members, by ballot, in several ways to help clear the liabilities, and it was the members of the E.T.U. themselves, by a large majority, who agreed to forego the benefits, and not run away from their principle, or allow others to turn on them and call them dishonest, they having incurred liabilities with no intention of paying them, and I am proud to be able to say that the E.T.U. men have proved themselves true to their principle and honourable, for they have paid their debts and not run away, as "Floreat Electra" admits having done.

A. Calipé.

[We fail to see the force of M. Calipé's logic that because men sign a proposition form, and receive a standard rate of pay, they are necessarily all competent. It is one of the grievances of first-class workmen that under Trades Unionism the incompetent, ignorant, idle, unsteady man is placed on the same level as the clever, able, eminently respectable and industrious hand, who would only be too content to be freed from the fetters with which the Union bind him, and so earn just what his labour would bring him in, instead of a standard wage not necessarily a true gauge of his real worth. But such discussions as these are mere waste of time, ink, and paper, and we cannot, therefore, devote any further space to what, at most, is a very trivial point. The day will probably come when the scales will fall from the eyes of the British workman; Trades Unionism, as now carried out, will be known no more, and every man will succeed, or fail, according to his individual merit.—Eds. Elec. Rev.]

Concentric Cables v. Bare Strip.

I at once admit that "absolute impossibility" was too strong an expression in connection with jointing on to live concentric cables; I should have said "utterly impracticable." Your correspondent, "J. H.," writes very glibly about cutting the outer, baring the middle, and connecting the leads, &c., but it is a very different matter to instruct an ordinary jointer to perform these interesting operations. Referring to the sketch which you have been good enough to forward me, I find that while severing the middle conductor of a triple concentric there is a clearance of about 1½ inch between this conductor and the clamp on the outer conductor, and since the pieces of wire that have to be cut and turned back are at least 5 inches long, I leave your practical readers to infer the probable results before the job was completed. Apart from this, the danger of cutting either into the insulation or the wires would be very great, as almost certainly the man's hand would slip, and cause his knife to short circuit the conductors. I regret to say that the illustration and description sent leave me convinced, as fully as ever, of the impracticability of safely connecting on to concentric cables carrying currents either under low or high pressure. An engineer who would attempt the former would be courting disaster, and one who would do the latter would be guilty of culpable folly.

I say nothing about the question of cost, but I do not think that the little bag of tricks illustrated in the sketch could be bought for less than something between 50s. and £5, whereas the cost price of a couple of clamps is under half-a-crown, and the time of making the joint less than an hour, against, I should say, at least six or eight hours.

The Writer of the Article.

Cost of Private Installations.

As one who intends adopting the electric light, I shall be glad if someone would inform me through your columns as to the actual cost of installation and running of a plant of 60 arc lamps, 350 incandescent, two elevators, and one fan. Is there a similar installation in existence, if so, where, and can I get the actual cost of running over a series of years? Your Review gives the cost of installation and running of public systems of supply, but not private; and, therefore, I venture to trespass on your space.

James T. Calvert.

Sunderland, *March 15th*, 1896.

Something Like a Storage Cell.

In your last issue (p. 336, col. 2), Mr. Herbert Lloyd refers to the secondary cells installed in the Boston Edison Company's station, "where each cell weighs about 3 tons, capacity 8,000 A.H., or 16,000 A.H. at 140 volts, with a maximum output of 8,000 amperes."

Of course, there is an error or misprint; perhaps two errors or misprints. The capacity is probably 16,000 A.H., since the ratio $\frac{\text{A.H.}}{\text{lb.}}$ could scarcely be lower than 2·2.

Desmond G. Fitz-Gerald.

The Paper Machine a Generator of Electricity.

With reference to the foot-note that you have inserted after my letter in the last issue of your Journal, I beg to state that the means that you there mention for getting rid of the electricity in paper as it passes from the machines have been tried over and over again, but they have entirely failed, and it is for that reason that I hoped to get some other suggestions from your numerous readers.

Henry Rogers.

Electric Elevators.

My article which appeared in your issue of the 21st ult. had for its only object to give to electrical engineers, or to intending purchasers, a general description of the Otis electric elevator. Your subsequent issues have contained references to it which are really not in the nature of controversy, but are simply in their essence claims that others have been enabled to do equally well. How far these claims have been established, I do not propose to discuss.

It was stated in my article that there were now more than 4,000 electric elevators in use. Such a statement indicates an amount of business which I can well understand would be likely to lead to an effort on the part of others to share in it. It appeared to me necessary, however, to trouble you with a communication which you were good enough to print in your issue of the 6th inst., and this I supposed would end the discussion. I have, however, before me your last issue of the 13th inst., and I must tax your courtesy so far as to ask your permission to say a few words further.

It is noticeable that in all that has been, or is said by our competitors, there is nothing more than a claim to be equally successful. It seems, however, now, that judging by the letter of Mr. Statter, we are to have a new competitor. Mr. Statter, I think, rather misses the point of my article when he says that the impression made upon him by reading it was "that the author considered the designer of the Otis lift to have been inspired." This is certainly far from the truth, but it was intended to be understood, by implication at least, that one of the great merits of the Otis machine was that it has served as an inspirer of others. In the development of the Otis elevator business through successive stages or periods, first with steam elevators, next with hydraulic, and now, concurrently with the hydraulic, the electric, we have found, as soon as we have successfully produced a new type, and it seemed to be coming into general use, plenty of those who tried—not to do a better thing, but to get round ours, and do something which could be claimed to be equally successful. This process will probably continue. I notice, however, that Mr. Statter has no adverse criticism to make of the Otis elevator; he simply announces the fact that he is about to enter the field, but does not describe his machine, as his patents are not yet completed. So far as he does give any idea of it, he is good enough to say, when speaking of one of its most important points, that "it is only fair to say that the principle is exactly the same as the Otis." Whether Mr. Statter, coming thus late into the field, will be enabled, when his patents are complete, to show us a better electric elevator may probably be seen.

I need only trouble you with a few words more. Both in my article, and in that which has appeared since, the objects to be attained were, first, to give such an amount of technical description as would interest engineers and intending buyers; and, second, to a certain extent, to promote business.

I think it no more than right to ask attention to Messrs. Waygood's letter, which appeared in your issue of the 28th ult. The whole subject of it is "Electric Lifts," and near the end of their letter they say:—

"That the electric lift has come to stay, we can testify by pointing to our shops overflowing with work, no less than 11 orders having been taken recently for lifts varying from 3 cwt. to 2 tons carrying capacity, and we continue to receive cuttings from local papers in Cape Town and elsewhere, describing the success of lifts we have exported."

Now, I think that your readers will certainly have understood this to refer to electric lifts only, as I certainly understood it when reading it. It is quite true that it is not so stated, but, whether intended or not, I think it has been, and will certainly be, so understood. The ordinary reader would understand, for instance, that the cuttings from local papers printed in Cape Town and received by our friends were referring to the electric lift. It so happens that one of our directors was in Cape Town in January. He left there on January 21st. At that date, one electric elevator had been shipped to Cape Town by Messrs. Waygood & Co. It was not then running, and when our director inquired as to the probable date of its completion, he was told that it would probably be a month from that date before it would be ready for use. Press cuttings, therefore, from Cape Town regarding the success of the Waygood elevators, could not have referred to electric elevators. The reference must have been to hydraulic. This being so, it is, perhaps, an allowable assumption that of the 11 orders in the works some at least might have been hydraulic. I regret to have to call attention to this, but it has interest for those among your readers who may be intending purchasers. If I have been misinformed as to the Waygood electric elevator, which our director saw being the first, no doubt Messrs. Waygood and Co. will clear up this point, and set me right.

Wm. Aug. Gibson,
Managing Director, Otis Elevator Co., Limited.

Röntgen Rays.

Last night I received the following telegram from Edison, which, I am sure, will interest your readers:—

"Just found calcium tungstate properly crystallised; gives splendid fluorescence with Röntgen ray, far exceeding platino-cyanide, rendering photographs unnecessary.—(Signed) Edison."

Kelvin.

March 17th, 1896.

With reference to the interesting article appearing in your last issue, wherein it was stated that two minutes was a very short time to obtain a good result with X rays, we think it will interest you to hear that our electrician succeeded in obtaining several good negatives instantaneously (*i.e.*, about ½ second exposure) with a new vacuum tube. We herewith enclose you a rough print from one of these negatives.

D. H. Bonnella & Son.

[The photograph is remarkably clear, but that from which our illustration of last week was taken is superior. Still, Messrs. Bonnella's print seems good enough for all practical purposes.—Eds. Elec. Rev.]

Private Electric Lighting Supply.

I shall be obliged if you will tell me if I am right in putting down an electric light plant to supply the tenants on a private estate, and *charging* them for current consumed. A gentleman connected with the vestry in which the estate is situated, informs me it would be necessary to get a provisional order before so doing. Will you please put me right in this matter?

Landlord.

[Unless there is any intention to cross public roads, a provisional order would be quite unnecessary.—Eds. Elec. Rev.]

Cheap Transport.

Will you be good enough to allow me space for some observations on the subject of cheap transport, because not only is the agricultural interest deeply interested, but also such manufacturing engineers as ourselves.

The President of the Board of Trade is evidently anxious to encourage by statute the construction of cheap steam or electric tramways, which will no doubt be facilitated by the Bill now before the House; but many engineers, fully conversant with all the conditions of the problem, are of opinion that cheap transport will be more effectually and quickly secured by self-propelled vehicles than by tramways, especially tramways operated by steam locomotives. The development, however, of horseless locomotives is at present completely blocked by the Locomotive Acts.

Many years ago Parliament declared that every vehicle propelled by other than animal power was a locomotive, and that no locomotive should be used on highways, except on conditions which, if not absolutely prohibitive, discourage not only their use, but also engineers from devising better machines.

If engineers had had free scope for their inventive faculties, there is no doubt that traction engines would have been so greatly improved, that the wear of the roads in transporting the same volume of traffic by mechanical appliances would have been greatly less than by horses.

It is, therefore, earnestly to be hoped that Mr. Chaplin will have the courage to adopt a broad and enlightened policy, and that his too long delayed Bill, dealing with mechanical traction on highways, will abolish the Locomotive Acts altogether.

The Highway Acts and common law are fully adequate to protect the public safety and interests.

But my principal object in addressing you is to invite the attention of the public, and especially of our legislators, to the injurious effects of the enactments referred to on our manufacturing industries, both as regards home and foreign business.

Railway construction was first developed in this country, and the early experience gained by our contractors and engineers secured to us for many years a monopoly of railway construction and equipment—rails, locomotives, &c.—all over the world.

New and improved methods of locomotion are now being developed, and the want of opportunities or facilities to our

manufacturers for acquiring experience in the new methods and machines is seriously affecting our trade, and allowing other nations to secure a monopoly of the new business, similar to that which this country enjoyed in respect of railway construction.

English engineers, for the reasons indicated, have less experience in the construction of electric tramways and horseless vehicles than our Continental or trans-Atlantic neighbours. While Germany and America reckon their electric tramways by thousands of miles, we can only count by tens, and France has hundreds of horseless vehicles against our units. The result is, that while our engineers are feeling their way in the new methods of traction, the Americans and Germans have not only equipped their own tramways electrically, but are rapidly acquiring a monopoly of the business in other countries.

American engineering companies are, with American capital, providing South Africa with electric tramways, *and also even England and Ireland.* The Germans, besides equipping their own tramways for electric traction, are doing the same for other Continental nations.

Thanks to facilities for acquiring land and tramway concessions in other countries, foreign engineers have had opportunities for gaining experience denied to engineers at least equally skilful at home, and foreign capitalists have learned how profitable electric tramways may be, and freely provide the necessary funds to support their engineering firms.

English visitors to Paris are surprised by the number of horseless vehicles in the streets, and the ease with which they are controlled. It must be evident to everyone that the experience which French engineers are now gaining in the construction of these carriages will give them a great advantage, even in our own markets, when Parliament does at last move and abolish the restrictions to their use.

We hear complaints of the want of enterprise of our manufacturers in prosecuting foreign business, but in this case at least the blame does not lie with them, but with Parliament and local authorities.

It is not the object of this letter to enlarge upon the advantages of the new forms of traction, but I may refer briefly to the benefits electrically propelled carriages would confer on London.

The electric carriage occupies a smaller area of the street than carriages with horses, and much less in proportion to the number of passengers.

It is believed that the successful electric carriage must have elastic tyres, either rubber or pneumatic, and if so the wear on the streets will be reduced to a minimum.

There is no objectionable noise, no smoke, ashes, or manure, and locomotion in the electric carriage is more agreeable to the passengers than in the ordinary carriage or omnibus.

As regards safety, the electric carriage is more effectively controlled than the ordinary horse carriage.

Even if no other object were to be attained than relief to London traffic it is earnestly to be hoped that Mr. Chaplin will not delay proceeding with his Bill to emancipate the horseless vehicle.

James Gray,
Secretary, the Electric Construction Company, Limited.

March 17th, 1896.

Electric or Steam Locomotion, &c.

In the article published in your last issue, on "Electric or Steam Locomotion," it is stated that the shunting and yard work is one of the greatest difficulties of the electrical system. It seems to me that storage battery locomotives would be eminently suited for this class of work. They would not have to be used continuously, so an excessive weight of batteries would not be required, and they could be charged from the line wire in position while the locomotives were not being used, thus saving the expense of handling the batteries, which has hitherto been one of the heaviest items in accumulator traction. The speed would always be low, so there would not be much "washing" of the acid, which is one of the chief causes of shedding of the peroxides, and as the locomotives would always be near the charging points, there would be no necessity to over-discharge the cells.

I should be glad if Mr. Mavor would tell me how it is usual, in installations fitted on the concentric system, to fit lamps in passages so that they can be switched on at one end and off at the other? This is usually done with two-way switches and three wires. Are special metal-clad two-way switches and triple concentric wire made for this purpose?

G. C. Allingham.

Switching Alternators in Parallel.

Perhaps you, or some of your readers, could tell me the best way of switching two one-phase 32 kw. alternators in parallel, automatically, the said alternators being 5-6 kilometres distant from each other.

A. Knapton.

Bilbao, *March 11th*, 1896.

[There is no automatic method for switching in alternators in parallel. The distant alternator to be thrown in is started precisely as a synchronous motor would be; that is, its speed is run up to slightly over synchronism, and the exciting current adjusted so that the voltage of the machine is slightly greater than the voltage on the mains to which it is to be coupled. If under these conditions the alternator is switched in, it will fall at once into step. All these operations depend on the eye and hand of an attendant, but occupy a few minutes only.—Eds. Elec. Rev.]

Design of Small Dynamos.

Being desirous of constructing a small dynamo according to the indications given in the Electrical Review of December 21st, 1894, January 4th and February 15th, 1895, I have the honour, before commencing the work, to present the two following objections, and to ask you to kindly give me some information.

1. In the issue of December 21st, 1894, page 739, line 32, it is said:

"We shall give two windings, one for high speed and large output, and one for slow speed and small output."

But, on carefully studying the articles in question, I have only found one winding for the armature. I should feel greatly obliged if you would have the kindness to give me the second winding, which is the one I want for my dynamo.

2. In the issue of January 4th, 1895, page 26, line 27, it is said:

"A bobbin wound to a depth of 1 inch will hold this wire, if 5½ inches long, and the number of turns of wire will be 3,000, nearly, &c."

But, on applying to this particular case the general formula given on page 565 of Messrs. Munro and Jamieson's pocket-book for 1892, N, number of turns $= \frac{R - 2}{d^2} \times h$, in which

$$R - 2 = 1 \text{ inch}; \; d^2 = 0{\cdot}025^{-2}; \; h = 5{\cdot}50.$$

I find: $N = \frac{1}{0{,}000{\cdot}625} \times 5{\cdot}50 = 8{,}800.$

This result, differing greatly from the one you give, I rely upon your well-known kindness to enlighten me on the subject, as it is impossible that the insulating material of the wire, which I have ignored in my calculation, would produce such a great difference.

Chastenet de Préfort.

Brest, *March 10th*, 1896.

[The formula in Jamieson's book does not take into account the thickness of the insulation on the wire, and this counts for a great deal in small wires, although it does not amount to much on large wires. A wire of ·025 diameter covered with cotton, would probably measure ·039 with the insulation, so that 3,000 turns in the space given is not far out, if any, and ample space is preferable to scanty space. For the second winding, double the number of turns of wire of half the diameter are required on the armature, giving about half the speed with same voltage and half the current. —The Writer of the Articles.]

"Recent Improvements in America and Europe in the Storage of Electricity."

Under the above heading in your last issue I read a statement to the effect that "in Birmingham, England, a storage battery road has been in operation for some six or seven years, and has been the experimental ground for almost all

makers of battery. . . . A little over a year ago the Chloride Syndicate got a contract for all the cars of this line, and with the experience of their allied company in France, they have been entirely successful." As a Birmingham citizen who has constantly used this line and carefully watched its working from the commencement, I am at a loss to reconcile this assertion with the unfortunate figures published by the last balance-sheet, showing a loss in the working of this line for the year ending June 30th, 1895, of £1,735, figures which cannot be satisfactory to the shareholders, even if the Chloride Syndicate consider them eminently successful. Many besides myself would be glad to have the mystery of such balance-sheets cleared up, more particularly when the above figures are compared with those of previous years. Thus in 1891, when the entire outfit of the road was brand new, the batteries in use being, I believe, those of the Electric Power Storage Company, the working of the line showed a profit of £3,020; but the unsuitability of these batteries to stand the strain imposed upon them seems to be the only apparent cause for the next balance-sheet (June 30th, 1892) showing a loss of £1,679. Anyway, towards the end of this year, 1892, the directors, or their advisers, substituted an entirely different type of battery, viz., that of the Epstein Accumulator Company. The results of this change, judging by the only facts accessible to us outsiders, the figures of the next balance-sheets, show already in June, 1893, a reduction in the loss to £98 for the year, while the balance at June 30th, 1894, is a profit of £1,214. In the face of this, we are now told that the Chloride Syndicate got a contract about this date for the equipment of the line with their battery, and have been entirely successful; the publication of the last balance-sheet (for June 30th, 1895) meanwhile showing a sudden jump back of the balance from a profit of £1,214 to a loss of £1,735. Perhaps some of your readers may be in a position to enlighten us upon these points.

This particular tramline, running through one of the most beautiful roads in any city of the whole world, has certainly been made an experimenting ground, too much for the comfort of the residents concerned, as well as for the good of the proprietors. As an example of accumulator traction, it has aroused interest everywhere, and is quite capable, if properly handled, of demonstrating the possibility, so much desired, of a cleanly, quiet and cheap tramway service, free from both snorting smoking locomotives, and from unsightly cables and posts.

I think your journal must be the right medium for discussing the whole matter.

S. Jevons.

March 16th, 1896.

THE NATIONAL TELEPHONE COMPANY'S STAFF DINNER.

The third annual dinner of the National Telephone Company's staff was held at the King's Hall of the Holborn Restaurant on the 13th inst., the general manager, Mr. W. L. Gaine, being in the chair. The dinner was largely attended by the staff, amongst those present being Messrs. Anns, Goddard, Sinclair, Chambers, Clay, Claxton, Coleman, Gill, Phillips, Preston, Shepherd, D. J. Smith, and Watson. The directors present were Lord Harris, Messrs. Agnew, Franklin, W. A. Robertson, Sir A. K. Rollit, Messrs. Smith and Quilter; and amongst the visitors were Sir Robert Hunter, Mr. J. C. Lamb, C.B., C.M.G., Mr. W. H. Preece, C.B., F.R.S., Mr. Fischer, C.M.G., Mr. Hookey, and Mr. Gavey, of the Post Office, Prof. Hughes, F.R.S., Mr. H. E. Clare, Mr. F. Crisp, and Mr. Chetwynd.

The usual loyal toasts having been proposed by the chairman, and honoured in the usual way, Mr. Franklin called upon those present to drink to the toast of the Houses of Parliament, and, in doing so, emphasised our indebtedness to the Upper House. Lord Harris, as a member of that august body, was called upon to respond, which he did in suitable terms. A reference to the cricket field was received with such enthusiasm as to rather throw into the shade the field of politics, so far as it was surveyed. Sir Albert Rollit responded for the House of Commons, and gave evidence of the hard work undertaken by that body by arriving at the dinner only shortly before he was called upon to speak. Although the House of Commons had done much, he felt there was much left to do, and especially so in electrical matters. The members of the House of Commons were ever watching the interests of their constituents. Nothing came amiss to the House of Commons. At one time they were concerned for pure water—a matter of the utmost importance to everybody—at another time it was pure beer. This reference to the little bill which Mr. Quilter had backed was enthusiastically received, and the enthusiasm was still further manifested when Sir Albert proceeded to remark that if the House dealt with the matter in a socialistic spirit, and made beer not only pure but free, he was certain it would be a most popular measure.

The Chairman then proposed "The National Telephone Company." He said they had not been inactive as a company during the year, having increased the *clientèle* by nearly 9,000. They had opened 50 more exchanges, and were now sending telephone messages through the kingdom at the rate of 313,000,000 per annum. They had been remodelling in many of the great centres the company's plant, and were about to enter on a new phase of their existence. The Government would take over the trunk wires on April 4th, and he assured the Post Office officials that they might rely on assistance and support from every officer of the company. The company would still continue to conduct the local services. Their relations with the Post Office would be in the nature of a partnership, in which each would serve the other. In all the great towns, if the local authorities were prepared to act on the powers Parliament had given them, the company was on its part prepared to make the system of the most complete description.

Lord Harris, vice-president of the company, in responding, said the undertaking was an immense one, and every effort would be made to adopt all the improvements which were on foot. He believed the public recognised that the company was doing all it could to meet their requirements, and to give them the best communication they could. They had to keep before them constantly that they were the servants of the public, and they fully appreciated the responsibility cast upon them.

In proposing "Electrical Science," Mr. Sinclair recalled the names of those scientists of the past or present to whom we owed a debt of gratitude; but he omitted one name, which was promptly filled in by Mr. Preece, in replying to the toast. "My earliest ideas on the practical applications of electrical science were gathered," said Mr. Preece, "at the feet, not of Demosthenes nor Gamaliel, but of one greater than those two—Faraday." "The Post Office," proposed by Mr. W. A. Smith, was responded to by Mr. J. C. Lamb, who expressed his sincere affection for the Post Office, which had been to him the university in which he had learnt all he knew. "The Board of Directors, and our other guests," proposed by Mr. Watson, was responded to by Mr. Quilter, and was followed by "The Staff of the National Telephone Company," proposed by Sir R. Hunter, and replied to by Mr. Anns, so soon as the applause due to his rising permitted him to obtain a hearing.

One other toast not on the list was proposed by Mr. Clay, and cordially received, viz., "The Chairman," which was replied to by Mr. Gaine with a brevity which characterised most of the speeches from the chair. We would suggest that Mr. Gaine's example should be followed at future staff dinners. It is not given to everyone to make after dinner speeches like Sir Albert Rollit or Mr. Preece, but if it were more generally recognised that "brevity is the soul of wit," we believe that the success of such gatherings as the National Telephone Company's staff dinner would be largely increased. An orator who expresses the intention of saying only "a few words" and reaches the "thirteenthly" of a noted preacher, should remember that he is one of many who have something to say. There should be some opportunity of communion amongst the members of such a staff, but there was no time for it at the last dinner. In every other respect the gathering may be regarded as a great success.

The Institution of Electrical Engineers.—By permission of Mr. Frank Bailey, a party of Students will visit the Amberley Road, Manchester Square, and Sardinia Street central stations of the Metropolitan Electric Supply Company on Saturday March 28th, at 3.30 p.m. Party to assemble at Amberley Road.

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—The last day for receiving proofs in the case of G. J. Reakes (trading as G. Reakes & Co.), electrical engineer, of Shrewsbury, is March 30th. Mr. T. Bullock, official receiver, of Shrewsbury, is the trustee.

At the London Bankruptcy Court last Tuesday, the first meeting of creditors was held under the failure of Walter Northcote Naylor, electrician and inventor, lately trading at New Cross Road under the style of W. Northcote & Co. In the absence of any offer, the case was left in the hands of the official receiver to be wound up in bankruptcy. The public examination is to be held on April 17th, at Bankruptcy Buildings, Carey Street, W.C.

At Greenock Sheriff Court on 13th inst., John H. Cox, electrical engineer, 46, Kelly Street, Greenock, was examined in bankruptcy at the instance of a creditor before Sheriff Begg. Mr. James Nicholl, accountant, was appointed trustee.

Dissolution of Partnership.—The partnership heretofore subsisting between Morgan J. M. Williams and Frank King, carrying on the business of consulting engineers at 39, Victoria Street, Westminster, under the style of Morgan Williams & King, has been dissolved by mutual consent as and from October 12th, 1894.

Liquidation Notices.—At meetings held at 38, Parliament Street, S.W., on February 20th and March 9th, 1896, resolutions were passed winding up the Weybridge Electric Supply Company voluntarily, and appointing Mr. Joseph S. Lobb, of 11, Queen Victoria Street, E.C., liquidator.

Creditors of Froggatt's Electric Lighting Company, Limited, are required, on or before March 23rd, to send their names, addresses, and particulars of their claims, &c., to W. P. Eldrid, 11, Old Jewry Chambers, London, the liquidator of the company.

Change of Address.—The registered office of the Yorkshire House-to-House Electricity Company, Limited, is, during the extension of the works, situated at 49, Aire Street, Leeds.

Catalogues.—The Electrical Company, Limited, has sent us a copy of the 1896 price list, strongly bound in green covers with gold lettering. The book is conveniently divided off into 13 sections by means of a thumb index. These sections are devoted to dynamos and motors; arc lamps; measuring instruments; switches and wall-plugs; knife switches; accumulator apparatus; lampholders; ceiling roses, cut-outs, and wall-plugs; carbons; wires, cables, flexible cords, &c.; fittings for theatres; incandescent lamps; electric bells. There is abundant information given in general descriptive and tabulated form, also prices and a large number of explanatory, sectional, and exterior illustrations. The company's customers will find the book of service.

Messrs. Chas. Winn & Co., of Birmingham, have recently issued a new list of their patent sight-feed lubricators. A quantity of letterpress and a goodly number of nicely executed illustrations describe the various types of lubricators made by them. There are the single connection, the independent condenser, locomotive, Admiralty, two-connection, and visible down-drop types, also Winn's improved engine lubricator, gun-metal lubricators, improved sight-drop bearing lubricator, and Winn's improved gun-metal rotary oil pump. Prices are included.

Divulging Trade Secrets.—Last week, in the Mayor's Court, Messrs. Wake and Sanders, mica merchants, of Great St. Helen's, E.C., sued two of their former clerks, Horace and Edward Calhaem, for damages for breach of duty in improperly disclosing the names and addresses of the plaintiff's customers. The defendants, young men, had, while in the plaintiffs' service, acquired a knowledge of the mica business, which was carried on by only six firms in London. Whilst in the plaintiffs' service they had, it was alleged, disclosed to another firm the names and addresses of the plaintiffs' customers, the prices at which they were selling mica, and at which they were accepting contracts. With this information the rival firm —which, it was suggested, consisted of the defendants themselves— had, it was said, undercut the plaintiffs in their business, and by sending out slightly lower tenders had obtained contracts which would otherwise have gone to the plaintiffs.—At the close of Mr. Wake's evidence, a consultation took place between counsel and the recorder in the latter's private room, with the result that, by consent of the parties, a verdict was returned for the plaintiffs against each defendant for £10, and an injunction was granted. The plaintiffs estimated their loss over the matter at £250, and they agreed to forego their loss as the defendants were young men just starting in life.—The learned judge said he thought they had not only been just, but generous, and the defendants might have found themselves in a much more serious position, as there was such a crime as conspiracy.

Electric Current Bill.—At the Guildhall last week, before Mr. Alderman Faudel Phillips, the Initial Perforating Company, of 36, Basinghall Street, was summoned by the City of London Electric Lighting Company, Limited, for the sum of £4 18s. 3d., for the supply of electric current. The Alderman made the order with costs.

High Voltage.—The Edison and Swan United Electric Light Company announced that in order to meet the present requirement for fittings of a high insulation for high voltage currents, they are now ready to supply, under their patent, No. 18,162 of 1891, switches, cut-outs, and holders, with patent enamel liners.

New Business.—Mr. M. E. Bailey, who for 14 years traded as M. Bailey & Co., at the Cadby Steam Works, Leather Lane, London, E.C., has now commenced the manufacture of incandescent lamps at 47, Waterloo Street, Glasgow, under the style of the Glasgow Electrical Lamp Manufacturing Company.

Reduction of Capital.—The petition presented on November 27th, 1895, for confirming a resolution reducing the capital of the Manchester Edison-Swan Company, Limited, and Reduced (formerly named the Manchester and District Edison Electric Light Company, Limited) from £550,000 to £350,000, is directed to be heard before the Vice-Chancellor of the Duchy and County Palatine of Lancaster.

The Safety Wall Plug (Patent).—We give particulars below of two new types of safety wall plugs which are being placed upon the market by Messrs. Hodges & Todd. Pattern A, in which the plug contact is inserted horizontally, and B in which it is inserted vertically. The following advantages are claimed for these safety wall plugs, viz.:—1. Absolutely impossible for the fuse wire in melting to fall across on the opposite pole and strike an arc or produce a short circuit, no matter how the wall plug is fixed. 2. It is impossible to produce a short circuit by the insertion of the plug connector. A short circuit can only be made intentionally, and then only with difficulty. 3. One pole only is exposed. 4. Large rubbing surface on both poles. 5. None of the working parts screw into the porcelain, yet there are no exposed back contacts. 6. High insulation secured by mounting on bases of highest quality porcelain. We

Fig. 1.

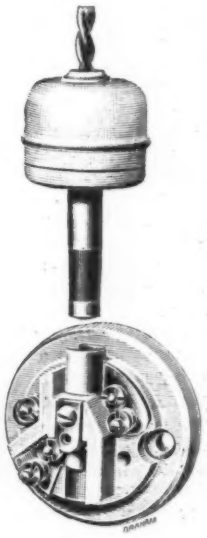


Fig. 2.

illustrate pattern A (figs. 1 and 2), which, in addition to the above advantages, is the only wall plug in which the plug connector can be inserted in the side. It is agreed that wall plugs should be of small size and neat appearance, and as flat as possible. This pattern does not project from the wall more than 1½ inches, and the plug connector can be inserted or withdrawn even with anything close against the socket. All other wall plugs are stated to require at least ½-inch of clear space in front of them. Being the only side contact wall plug, it is the only one on the market which can be used behind bookcases and other articles of furniture. It can be used on skirting boards to great advantage, whereas other wall plugs, owing to projecting so far from the wall are constantly in danger of being knocked and broken. It is the only wall plug which can be fixed or re-fused on a "live" circuit; it being frequently the custom to fix wall plugs on open circuits the advantage of this is obvious. This patent was brought out by the Electrical Installation Company, Limited, Victoria Street, S.W., and the wall plugs are now being manufactured and placed on the market by Messrs. Hodges & Todd.

The Lithanode Electric Storage Company, Limited.—This company has found it necessary, owing to increased business, to enlarge its works and provide more adequate accommodation for offices and showrooms. Accordingly, they have secured premises at 3, Harvey's Buildings, Strand, W.C., where, in future, all the business of the company will be transacted, and all communications should be addressed. The new premises include offices, showrooms, laboratory, and stores of material required for temporary and decorative electric lighting. Arrangements have also been made for recharging and repairing portable batteries at the above address, but the works will continue to be at 64, Millbank Street, Westminster, S.W. We have received from the company a new list (February, 1896) which describes, illustrates, and gives prices of the Lithanode electric lighting cell, electric hand lamps, portable batteries, medical batteries, and testing cells. The sheets are very nicely got up.

The New Photography.—Great improvements have been made, during the past few weeks, in the Röntgen photography, and the process has now been sufficiently developed to render it of practical value in surgery and medicine. Its successful application, however, requires expensive apparatus and special appliances, the

working of which necessitate some technical knowledge. Under these circumstances, acting on the advice of several eminent physicians and surgeons, Mr. A. A. Campbell Swinton has decided to establish at 66, Victoria Street, S.W., a laboratory specially devoted to the purpose. This will be equipped with the most improved apparatus, which will be added to as experience and experiment show to be advisable. The work will be carried out, under Mr. Swinton's supervision, by one of his assistants, Mr. H. L. Tyson Wolff. It is hoped that these arrangements will prove of service to medical men who may desire to have the process applied to their patients. The laboratory will, it is expected, be in working order in the course of a few days.

The authorities of Faraday House, Charing Cross Road, have placed in one of the private rooms the necessary apparatus for photographing by means of X rays. This has been done at the suggestion of prominent members of the medical profession, and, already, a large number of negatives have been produced. The apparatus is manipulated by the staff of the Institution, but it is desirable that patients should be accompanied by the medical gentlemen who are attending them.

The Hermite Electrical Sanitation Process.—The installation of this system at the Military Hospital, at Netley, has now been working since the beginning of the year, and a visit of inspection was made a few days ago by the War Office authorities, who, we understand, expressed themselves thoroughly satisfied both with the effect on the main sewer and the effluent; and also with the remarkable improvement in the atmosphere of the various wards. The wardmasters are also unanimous in their approval. The French War and Naval Departments have officially approved the system, and are considering to which of their stations it shall be first applied. The Brazilian Government has given instructions for the Marine State Hospital at Rio to be fitted with the Hermite process on the same lines as the Victoria Hospital, Netley. As to the success of the demonstrations of the Hermite process at Rio last year, it may be of interest to state that in that part of the city where the working of the plant has been continued, not a single case of yellow fever has occurred, though it is a most unsanitary spot, and in previous years has suffered severely. We are informed that other parts of the city have suffered as usual from the periodical visitations of this scourge.

ELECTRIC LIGHTING NOTES.

Aberdeen.—A deputation from Aberdeen Harbour Board have inspected the Docks at Liverpool and Manchester in view of the introduction of the electric light at Aberdeen Harbour. The deputation think it would be more satisfactory for the Harbour Board to obtain the necessary supply of current from the Corporation mains, than to procure the expensive plant that would be required for a private installation.

Asylum Lighting.—A special committee of the Northumberland County Council, reporting upon the lighting of the asylum, cannot see its way to recommend the substitution of electricity for gas on account of the cost compared with gas.

Bolton.—At a meeting of the Gas and Electric Lighting Committee last Friday, the resignation of Mr. J. H. Rider, the borough electrical engineer, was accepted, he having secured a similar appointment at Plymouth. It was decided to advertise for a successor at a commencing salary of £300 a year, although Mr. Rider was only in receipt of £200. Last summer Mr. Rider applied for an advance by £50 a year, but it was refused.

The tradesmen who have gone in for electric lighting are agitating for a reduction in the present charges. At the last meeting of the Gas and Electric Lighting Committee, a deputation attended and presented a petition, signed by nine-tenths of the consumers, praying that the Corporation may take such action as will materially lessen the cost to them for the use of the new illuminant. They suggested that the Corporation should adopt the scale now in force in Brighton. The matter is under the consideration of a sub-committee.

Brighton.—Five arc lamps are to be erected in Preston Road, between Springfield Road and Stanford Avenue, and in Stanford Avenue, between Preston Road and Beaconsfield Villas

Bristol.—Several further applications have been received for the supply of power, including one from the Bristol Docks Committee for the Bristol Granary. Another application was for the supply of light on an extensive scale to premises in Bread Street, St. Philip's. The engineer has been instructed to report upon the various applications. Up to date, applications have been received from 566 customers for 30,509 lamps, and of these 489 customers have already been supplied with 28,021 lamps.

Burton.—Messrs. Hall, Geary & Co. have secured the contract for the lighting of the new steam cooperage and stores for the Burton Brewery Company, Limited, consisting of a dynamo (130 amperes 100 volts), and arc and incandescent lamps. They have also secured the contract for lighting a large new residence in High Street, Burton, for Messrs. Bass, Ratcliffe & Gretton, Limited, taking current from the Corporation mains.

Camberwell.—A ratepayers' meeting the other night passed resolutions condemning the action of the vestry in assenting to the electric lighting powers of the district passing into the hands of the County of London and Brush Provincial Companies, asking them to reconsider the question, and also urging the Board of Trade to refuse its sanction to the order sought by the company.

Cardiff.—One outcome of the recent complaints from fitters at the electric lighting works is the reoganisation of the staff there. The four fitters themselves are receiving notice, and three engine drivers and one qualified fitter are to be engaged instead.

Chiswick.—The Council's Law and Parliamentary Committee, and the representatives of the Duke of Devonshire, cannot agree as to the nuisance clause in the agreement *re* electric lighting works and dust destructor.

Coventry.—Mr. R. Hammond, in a report upon the electric light works, calls attention to the immediate need of further extension of the plant. The expenditure incurred up to date amounts to £23,485. Mr. Hammond gives details of the two generating sets which have been laid down, with a total capacity of 150 kilowatts, permitting connection to the circuits of the equivalent of 7,500 8-C.P. lamps. He points out the necessity of maintaining a completely equipped set of plant as a reserve. The actual working capacity of the present plant, after setting aside one set as reserve, is only 2,500 8-C.P. lamps. The number of lamps connected is 3,026, and the number awaiting connection 586, making a total of 3,612. The safe limit of 2,500 lamps is therefore already passed. It is estimated that there will be by next winter a total of 6,000 lamps. With 6,000 lamps connected it is assumed that the maximum number in use at any one time would not be less than 4,620. Mr. Hammond suggests the laying down of a new set of plant of 400 I.H.P., 200 kilowatt capacity, at an estimated cost, with additional cables, of £8,900.

Chester.—The Mayor, addressing the Council the other day regarding the electric lighting works in progress, stated that they were advised by Professor Kennedy that it would be false economy to lay down too small buildings and plant, and in consequence were proposing an expenditure of £22,000, or an addition of £6,000 over the original estimate.

Fauldhouse.—At a meeting of the inhabitants of Fauldhouse, the report of an inquiry into the probable cost of introducing and maintaining the electric light for the streets was submitted. A capital of £1,000 or £1,200 would be required, with an income of £150 yearly. The meeting resolved to continue the present system, that of oil lamps maintained by voluntary subscription.

Folkestone.—The Pavilion Hotel is to be fitted up with a complete electric lighting and electric bell system.

Hampstead.—At the last Vestry meeting complaints were made of the cost of the electric lighting of Finchley Road, and an attempt was made to pass a resolution substituting gas. The motion was, however, lost. An architect has been appointed to prepare plans and specification for the necessary additions to the electric lighting station, and to superintend the carrying out the work.

Haslingden.—The Council has instructed the Town Clerk to obtain an electric lighting provisional order. A committee has been appointed to obtain information on the subject.

Islington.—The Vestry has entered into arrangements with the County Fire Office for increasing very considerably the insurance of the electric lighting station.

Longford.—Mr. Thomas Fee has fitted up his extensive premises with electric light. It is stated that Mr. Fee has it in contemplation to extend the system in order to enable him to enter into contracts with residents of the town to light the business and private houses, and, possibly, to endeavour to procure the lighting of the streets.

Monifieth.—A public meeting is to be held at an early date to consider the whole matter of lighting either by gas, electricity, or other illumination.

Stanton.—The contract for the lighting of Stanton Village by electricity has been secured by Messrs. Hall, Geary & Co. Current will be taken from the Earl of Carnarvon's colliery plant which the firm has just completed, having put in a dynamo amply large for this purpose.

Sunderland.—Mr. Frederick Gordon is having the electric light fitted throughout his mansion, The Briery, Thornhill. From chandeliers and brackets there will be suspended 250 lamps of 16-C.P. Mr. Gordon, at first, decided to have a private generating plant put in, but on consultation with Mr. D. Taylor, jun., his electrician, and Mr. Brown, the borough electrical engineer, the idea was given up in favour of the Corporation supplying the current. The whole of the work has been carried out by Mr. D. Taylor, jun.

The London School Board Offices.—The School Board for London has determined, says the *City Press*, to make an alteration in the system under which the electric lighting is carried out at the head offices on the Victoria Embankment. Hitherto the eastern portion of the offices has been lighted by current supplied from the mains of the Metropolitan Electric Supply Company, and the remainder (considerably the greater portion) has been lighted by means of the Board's own dynamos. The cost of working the Board's engines, dynamos, &c., for the year ending December, 1895, was £806; and the cost of supplying the eastern portion of the offices from the company's mains during the first five months of the year was only £70. The provision by the Board of its own electric current has, therefore, proved a costly experiment, and it has been decided to abandon the work, and to obtain the whole of the supply in future from the mains of the Metropolitan Electric Supply Company. It is estimated that, under the new arrangement, the six winter months will cost £318, and the six summer months about £70, making a total of £388. Under the old system the cost was over £900.

Tasmania.—We learn that the electric light has now been installed permanently at Launceston, Tas., Messrs. Siemens Brothers having recently started the final trial of six months, prior to handing over the works to the Corporation.

Whitehaven.—Dr. John Hopkinson's report regarding the public lighting system, and his test of the cables, was before the Council last week. He found that the contractors had not complied with the contract, the insulation was enormously below the standard, and the conductors could not be brought up to it without laying, to a large extent, a fresh cable. He had been in communication with the contractors, who sent down additional men to relay the entire cable that supplied Bransty. Dr. Hopkinson suggested certain improvements and alterations in the system, and these are estimated to cost £1,616.

Windsor.—After protracted discussion in the Town Council, and weary waiting by the inhabitants, Windsor is once more to have the electric light. The partial installation laid down by a company in 1893 failed through financial difficulties and other reasons, and having had but a brief and very limited experience of the light, the borough was thrown back upon gas and oil. Last year, however, the Corporation were induced to apply for a provisional order on their own account, and having secured it, they have now leased it to a new company. This company—the Windsor and Eton Electrical Installation Company, Limited—having a nominal capital of £15,000, in 15,000 £1 shares, propose to get to work with as little delay as possible, and already have their scheme cut and dried, and drawn up by Mr. A. H. Preece, A.M.I.C.E., their consulting engineer; Mr. A. E. Farrow being their resident engineer. On the strength of personal canvass, it is calculated that 4,000 lights will be required at the outset. The system recommended by Mr. Preece for adoption is the three-wire low pressure continuous current. The generating plant is to consist of two high pressure steam boilers. There will be two combined engines and dynamos. Each combined engine and dynamo will be of sufficient capacity to light about 2,000 lamps burning at the same time. A large set of accumulators will be installed as a reserve.

York.—In his report on the scheme for the city electric lighting, Prof. Kennedy recommended the increase of the proposed loan from £15,000 to £20,000, so that the work might be carried out efficiently. Prof. Kennedy is to meet the committee about the middle of April to discuss the matter.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Baker Street and Waterloo Railway.—In the House of Commons on Monday, on the order for the second reading of the Baker Street and Waterloo Railway Bill, Mr. Galloway Weir drew attention to the inadequate provision for the ventilation of the railway. Mr. Bartley said the Bill was for an extension of time, with provision for a slight extension of the line. Special clauses had been inserted in the Bill dealing with ventilation. The Bill was read a second time.

Dublin Tramways.—It is understood, says a Dublin paper, that the Master of the Rolls will to-day (13th inst.) hear the application for an injunction on the part of Sir Robert Sexton in the case of the Corporation and the rival tram schemes, if his lordship can get another judge to sit in his place to hear common-law motions. The object is to prevent the Corporation and the Southern Tramways Company making any use of the resolution passed in favour of the latter at the late meeting of the municipal body.

Giant's Causeway and Portrush Tramway.—Mr. Traill, manager of the Giant's Causeway Electric Tramway, asked the County Antrim Grand Jury, on 17th inst., for their approval to the changing of the present system of electric traction to the overhead system. The company proposed to erect posts on the inside of the footpaths, with projecting arms 18 feet above the road, to carry the wire. The Act of Parliament gave them the power, but they had thought it right as a matter of courtesy to come before the Grand Jury. The Grand Jury decided to give their approval to the change.

Leeds Tramways.—The Highways Committee of the Leeds Corporation who have the control of the city tramways, last week decided to proceed with the laying of the electric traction from the Canal Gardens to Kirkstall with the least possible delay. A special meeting of the sub-committee is to be summoned to arrange in what parts of the city the centre and side poles shall be fixed.

The Mersey Railway Company and Electricity.—At the meeting of this company, held last week in London, the chairman said the Bill they were promoting gave them power to use electricity if ever it were found desirable. He himself did not believe in electricity at present. When it was discovered that they could work with electricity profitably he should be prepared to adopt it, but at present the Mersey Railway was too poor to try experiments. Sir Douglas Fox, engineer to the company, said perhaps electricity might now be found to be the right motive power for the Mersey Railway, but it would be great folly to endeavour to introduce a compound system of electricity and steam locomotives.

TELEGRAPH AND TELEPHONE NOTES.

Damaging Telephone Insulators.—Three youths named William Sidley, Percy Pattinson, and Thomas Ball were charged at Manchester City Police Court, before Mr. Yates, Q.C., and other magistrates, with damaging telephones at Reddish, on March 1st. Mr. Preston, who prosecuted on behalf of the National Telephone Company, said there were thousands of pounds damage yearly sustained by the company by such an offence as alleged against defendants. It was that of throwing stones at the insulators on telephone posts. Defendants admitted the offence, and the Stipendiary, in addressing them, said that they had been guilty of a very serious offence. The Lord Chancellor had introduced a Bill that would be a very good corrective in the present case. Defendants, in the circumstances, would be fined 5s. or seven days,

Edinburgh Telephone System.—The Lord Provost's Committee of Town Council received a deputation last week consisting of the manager, one of the directors, and several officials of the National Telephone Company with regard to an improved system of telephones in the city. It was remitted to a sub-committee to fully consider the matter and report.

French Cable Matters.—We see in the *L'Eclair*, of Paris, that the Financial Committee of the Senate adopted, on Saturday last, the Bill subsidising a submarine cable between France and America. A recent meeting was held under the presidency of Monsieur Denormandie, Senator and President of the Comptoir National d'Escompte. At this meeting Mr. J. Depelley, Manager of the French Submarine Cable Company, dwelt upon the great *rôle* played by cables in the commercial development of English colonies and also on their extreme importance in war time, and from this deduced the great dangers run by France through the almost complete absence of direct communication between that country and her colonies Mr. Depelley stated that it was absolutely necessary for France in the interest and for the safety of French colonial development to possess a system of telegraphic communication absolutely independent of any English monopoly. The Bill which has been passed by the Chamber of Deputies constitutes the first encouragement in this direction and marks the starting point of the establishment of an independent French system of which the creation is imperative. During his discourse, Mr. Depelley presented a large chart of the telegraph communications of the globe, which showed in a very astonishing manner the considerable importance, and, at the same time, the great danger of the English system, which binds up the whole world in a veritable spider's web.

Pacific Cable Conference.—The Pacific Cable Conference, which is to meet at the Colonial Office directly after the Easter recess, is looked forward to, says the *Daily Chronicle*, with the keenest interest in Colonial circles here and in Canada and Australasia. The two Agents-General who are to represent Australasia are now awaiting their instructions from the Colonial Governments; and the Canadian delegates, Sir Mackenzie Bowell, the Canadian Premier, and Mr. Sandford Fleming, to whose engineering skill Canada owes in a large measure the Canadian Pacific Railway, will bring their instructions with them from Ottawa. Definite tenders will be before the conference, and their chief business will therefore be to decide, not the feasibility of the cable or its cost, but the allocation of the costs between the Colonies and the mother country, and the knotty problem whether it shall be a State cable or a company undertaking. There is a strong Colonial demand for an all-British cable, both to Australasia and later on to South Africa, and the Colonies seem ready to pay their share of the cost.

Telegraphic Interruptions and Repairs:—

	Down.	Repaired.
Cables.		
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
" " (P.Q.) ...	June 24th, 1895 ...	...
Brest-Penzance (P.Q.) ...	... ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Aden-Zanzibar	Mar. 16th, 1895 ...	...
Landlines.		
Communication with Matagalpa Provinces of Leon and Chinandega ...	Feb. 26th, 1896 ...	...
Trans-Continental line beyond Mazol (Mashonaland)	March 12th, 1896 ...	...
Telegrams for Tohikwawa and Blantyre cannot be accepted.		

The Proposed American Pacific Cable.—At a recent hearing before the Senate Committee on Foreign Relations, Mr. James H. Scrymser appeared to urge the interests of his company, which proposes to lay a Pacific cable. A bonus of $160,000 a year for a period of 20 years is asked from the Government, and in return the company will bind itself to for ever transmit all Government messages free of cost. The rate proposed for private Japanese messages, says a New York exchange, is $1.25 a word, and for Hawaiian messages 35 cents per word, the press rates to be one fourth of these. Mr. Scrymser stated that the only obstacle to the early and successful establishment of his cable is the so-called exclusive grant of the Hawaiian Government to Col. Spaulding, which, he says, is in the interests of an English cable company.

The Post Office and the Telephone.—The trunk telephone line between London and Portsmouth was formally opened by the Mayor of Portsmouth, Mr. J. J. Young, in the presence of members of the Town Council, and other representative bodies on Friday last. The Mayor of Portsmouth and the Lord Mayor of London exchanged congratulatory messages. The whole of the trunk lines in the South of England will be taken over by the Post Office on April 4th.

Telephonic Communication in Japan.—The Japanese Government is reported to be seriously considering a scheme for the extension of the telephone system, so as to connect all the leading commercial centres in the country.

The Chartered Company's Telegraph System.—The report of the British South Africa Company's directors, which was issued recently, contains lengthy particulars regarding its telegraph system. It states that Mr. Somerset R. French, Postmaster-General of Cape Colony, reports that the company's telegraph business is a flourishing one, and that the telegraphic system has worked successfully during the year, no complete interruption of communication of any moment having occurred. The work done during the past year included the completion of the new wood pole line between Buluwayo and Charter on February 7th, 1895, a few days only after the date anticipated in last year's report. This route follows the main line of development, and has been, and will continue to be, of great value to the company. Already a branch line from Gwelo to the Selukwe Mining District has been authorised, and is approaching completion. The proposal to erect an iron pole line between Mangwe and Macloutsie (96 miles) has been given effect to, and the work was completed on June 21st, 1895. As a consequence Macloutsie has become the transmitting station for the company's system in place of Palapye. The temporary military line between Palapye and Tati and Ramaquaban is in course of being dismantled; the material is, however, of little value. In order not to place Tati under any disadvantage in respect of this change of route, the line from thence to Mangwe has been strengthened by the alteration of the temporary military section from Tati to Ramaquaban (18 miles), into a wood pole line. Besides the foregoing and other necessary works, details of which are given below, which have been carried out under Mr. French's direction, the company has, under contract with the Beira Railway Company, completed the telegraph line from Chimoio to Salisbury. This line, although not formally taken over from the contractors, or connected with the system generally, was, under a temporary arrangement, made available to the public on September 16th, and in conjunction with the Beira Railway Company's wire to Beira, affords communication between Salisbury and its seaport. The total length of the telegraphic line under the control of the company south of the Zambesi now in operation is 1,354 miles. The company's traffic receipts during the 12 months ending March 31st, 1895, were £9,701, while the expenditure on working and maintenance was £6,432. For the six months ending September 30th, 1895, the receipts showed an approximate total of £7,631, and the expenditure £3,369. In the progress of a new country it is naturally a difficult matter to procure and retain a staff in all respects suitable for such an onerous service as that of posts and telegraphs, and it has been considered desirable to materially improve the pay and status of the officers of both branches, who have worked cheerfully and commendably under trying circumstances. The directors again desire to thank Mr. Somerset R. French, the Postmaster-General, Cape Colony, for having freely given, with the permission of the Cape Government, his valuable services in advising on the extension and general administration of the company's telegraph system. With regard to the construction of the Salisbury-Tete section of the line of the Trans-Continental Telegraph Company, Limited, it was anticipated, before this report appeared, that the line would have been permanently completed and handed over by the contractors to the company. Owing, however, to exceptional difficulties, caused principally by the scarcity of native labour, the shortness of water due to prolonged drought, and the rocky nature of the country beyond Mount Darwin, previous anticipations have not been realised, although temporary through connection was made with Tete on October 22nd, and the communication has been fairly well maintained since that date. The latest information in regard to this section is that 162 miles of permanent line have been erected, and there are 75 miles of a temporary character. Strenuous efforts are being made to finally complete the section without further delay. It may be added that an office at Mazoe, on this section, was opened on September 24th, 1895. Since communication was established with Tete on October 22nd, it has been maintained by joining the completed portion of the line from Salisbury to the Portuguese wire, which runs in a southerly direction from Tete, by means of a temporary line 62 miles in length. It was originally arranged that there should be no public telegraph office of the company within Portuguese territory; but at the request of the local Portuguese authorities, temporary arrangements have been made for the acceptance of telegrams at their local office at Tete—a step which has been of obvious local advantage, not only to the authorities, but to the public, in that it has placed Tete in telegraphic communication with Delagoa Bay, Mozambique, and the outer world generally. The importance to the Portuguese Government of the establishment of a permanent office at Tete, from an administrative point of view, and also on commercial grounds, is so great, that it may eventually be found to the advantage of all concerned, that a modification of the original stipulation be made. It should be mentioned here that the Portuguese Government has erected a telegraph line from Chinde to Tete, and that by using the Trans-Continental line, which runs through the latter place, the important shipping community of Chinde is brought into touch with other parts of Central and Southern Africa, as well as with Europe and the rest of the world generally. Chinde is the seaport of Northern Rhodesia and the Nyasaland Protectorate. Communication has been recently established between Salisbury and Blantyre, and congratulatory messages have been exchanged between the Right Hon. C. J. Rhodes, M.L.A., and Her Majesty's Commissioner and Consul-General, Sir H. H. Johnston, K.C.B. In connection with the projected extension north of Blantyre, 200 miles of material was shipped from the Clyde in the month of June last. The material is of a lighter description than that originally sent out, the poles being specially manufactured for the purpose, and the line will be much more economical in construction. The material was specially made up into packages weighing about 50 lbs., and duly classified in sections, so that when active operations are recommenced, there should be little difficulty in securing its distribution at the various depôts at a minimum of expense. A working agreement has been entered into between the African Trans-Continental Telegraph Company, Limited, and the British South Africa Company with regard to telegraph rates, which is mutually satisfactory, and which follows the general lines of the South African Telegraph Union.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—June 1st. The municipal authorities of Prague are inviting tenders for the erection of and equipment of a municipal electricity generating station in the town for electric lighting, power, and tramway traction purposes. Tenders are to be directed to the Stadrath der Haupt, Stadt Prague, Prague, Austria, from whom full particulars may be obtained.

Bedford.—April 4th. Tenders are being invited by the Electric Light Committee for the supply and erection of one 240 B.H.P. double-acting compound enclosed engine, and one 150-unit alternator, with stationary armature. Specifications, &c., may be obtained at the offices of Mr. T. S. Porter, Clerk to the Urban Sanitary Authority, Town Hall, Bedford.

Belgium.—March 25th. Tenders are being invited by the Belgian State Railway authorities in Brussels for the supply of a quantity of mica and insulated copper wire, about 1,000 incandescent lamps, and 180 dynamo brushes of various sizes, &c. Tenders to be sent to La Bourse, Brussels.

Bradford.—April 8th. The Corporation is inviting tenders for erection of a building required for the new electricity station at the junction of Valley Road and Lionel Street in the borough. Details on application to Mr. Thomas Barker, A.M.I.C.E., architect, at his offices, 5, Bond Street, Bradford.

County Antrim.—May 1st. The Commissioners for the control of Lunatic Asylums invite tenders for the supply and erection of an electrical installation at County Antrim Lunatic Asylum.

Edinburgh.—March 28th. Tenders are invited for the wiring of the City Chambers, for the Corporation. Specification, &c., can be obtained at the office of the Resident Electrical Engineer, 5, Dewar Place, Edinburgh.

Eston.—May 1st. The District Council invites schemes for lighting the district by electricity, such schemes to embrace (*a*) plan and estimated cost; (*b*) annual working cost and maintenance. Particulars from the District Surveyor, Grangetown, Yorkshire.

France.—March 31st. Tenders are invited for the supply of a multiple telephone switchboard. Tenders to be addressed to the Direction Générale des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

France.—March 24th. Tenders are being invited for the supply of 14 lots of paper rolls from 10 to 16 mm. wide for telegraphic apparatus. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

France.—March 25th. Tenders are invited for the supply of a number of telegraphic instruments, in eight lots. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

Lima.—June 1st. The Municipal Council is inviting tenders for the establishment and working of the electric lighting in the squares and streets of the city, with power to work the private supply under a 20 years' contract. Particulars to be obtained at the Peruvian Legation, 13, Comeragh Road, West Kensington, W.

Peru.—June 1st. The Municipal Authorities of Lima, Peru, are inviting tenders for the concession for the electric lighting of the city. Tenders are to be directed to La Legation de Perou, 8, Avenue Hoche, Paris, from whom particulars may be obtained.

Shoreditch.—April 14th. The Vestry invites tenders for engines, dynamos, pumps, mains, transformers, accumulators, &c., for the generating station. Specifications, &c., from Messrs. Kincaid, Waller, and Manville, 29, Great George Street, Westminster. For further details see our "Official Notices."

St. Pancras.—March 26th. The Vestry invites tenders for engines, dynamos, switchboard, and other apparatus in connection with the electric lighting extensions. For further details see our "Official Notices."

Wallasey.—The District Council is prepared to receive tenders for the undermentioned works, viz.:—*a*, Steam alternators, switchboard, and accessories; *b*, High and low tension concentric cables; *c*, Transformers. Particulars may be obtained on application to the Engineer, Mr. J. H. Crowther, at the Gas and Water Works, Great Float, near Birkenhead. For further details see our "Official Notices."

CLOSED.

Richmond.—Mr. C. A. Hemingway has secured the contract for the electric lighting of the Richmond County Courts.

Tunbridge Wells.—The Town Council recently accepted the tender of Messrs. Johnson & Phillips (£750) for plant required at the central electric lighting station.

LEGAL.

PETITION OF DOLBEAR AND THE BRITISH INSULATED WIRE COMPANY (LIMITED) FOR PROLONGATION OF LETTERS PATENT.

The petition for the extension of patent granted to Professor Dolbear in 1882 for "Improvements in Electrical Cables" came on for hearing before a Judicial Committee of the Privy Council on Wednesday last. The opponents of the petition were the Western Electric Company, the Fowler-Waring Company, and the National Telephone Company.

Mr. Fletcher Moulton, Q.C., Mr. Bousfield, Q.C., and Mr. Graham appeared on behalf of the petitioners; Mr. Cripps, Q.C., Mr. Roger Wallace, Q.C., and Mr. Walters represented the opposers; and the Attorney-General, Sir Richard Webster, watched the case on behalf of the Crown.

The petition set forth that "Improvements in electric cables granted to Amos Emerson at the Dolbear date of the letters patent was a new invention. The invention related to the insulation of electric conductors. It consists in reducing to the smallest possible extent the contact between the conductor and the surrounding insulating material, so that the conductor is as much as possible insulated by the surrounding air. By this means the rapidity with which electric signals can be transmitted through the cable is largely increased, the reason being that the inductive capacity of air is very low as compared with solid insulators, and consequently a much smaller Leyden-jar effect is produced with an air insulated conductor than with one which is in contact with a solid insulator. By an assignment dated May 25th, 1892, the petitioner, Amos Emerson Dolbear, assigned the said letters patent for the sum of £10 to "Patent Exploitation, Limited," whose registered office is at Liverpool, and the patent being assigned to Thomas Kerfoot for the same sum, he about the same time assigned it to James Basnet Atherton, by whom it was transferred to the British Insulated Wire Company, who were the registered owners of the said letters patent. The petition maintains that it was not until recently that any need existed for cables made according to Dolbear's patent. Notwithstanding the continued efforts of Prof. Dolbear to bring the said invention into public use, the invention did not come into any commercial use until quite recently, and neither of the petitioners had derived any material profit from it, as shown by accounts filed. The British Insulated Wire Company, Limited, are now in a more favourable position to obtain some reward in respect of the said invention, and are willing to make such provision for rewarding Prof. Dolbear as might seem fit.

The main grounds of objections raised by the Western Electric Company are that:—1. The said alleged invention was not at the date of the said letters patent a new invention within the realm, nor was the said Amos Emerson Dolbear the true and first inventor thereof. (*a*) At the date of the said letters patent it was a matter of common general knowledge that air was a dielectric having a lower specific inductive capacity than any solid insulating body. (*b*) It was also a matter of common general knowledge that in all cables which were placed underground or in the sea, the Leyden jar effect considerably retarded the transmission of electrical currents along the conductors. (*c*) It was also a matter of common general knowledge that in all cables of the character in the preceding paragraph mentioned, the Leyden jar effect of the cable varied with the specific inductive capacity of the insulating material used, and that, therefore, with air insulation the Leyden jar effect was at a minimum. (*d*) Long prior to the date of the said letters patent earlier inventors had used air as an insulator in the construction of electric cables, by reason of its known low specific inductive capacity.

The opponents will refer to the specifications of the following letters patent, all of which had been filed or deposited in the library of the Great Seal Patent Office prior to the date of the said letters patent.

1. Letters patent No. 2,326, of the year 1858, granted to Alfred Wilks Drayson for "Improvements in Submarine Telegraphic Cables."

2. Letters patent No. 3,099, of the year 1876, granted to Henry Potts Scott for "Improvements in Telegraphic Wires and Cables, &c."

3. American letters patent No. 172,495, of the year 1876, granted to William E. Prall for "Improvement in Insulating Telegraph Wires."

The opponents allege that by reason of the public general knowledge referred to in paragraphs (*a*), (*b*) and (*c*) hereof, and the inventions disclosed in the specifications of the three patents hereinbefore referred to, there was no novel invention protected by the petitioner's said letters patent, or alternatively, if there was any invention forming the subject of valid letters patent, the invention was one possessing no special merit, but involving only slight structural modifications in cables already described and patented.

The opponents go on to show that the specification filed at the American Patent Office was on several occasions amended until the language describing broadly the alleged principle had been eliminated from the specification.

The petitioners, notwithstanding the fact that the said prior letters patent were well known to them, the same having been expressly brought to the knowledge of the petitioner, Amos Emerson Dolbear, in the application for the said American patent, wholly refrained from referring to the same in their petition, and allege in the third and ninth paragraphs thereof, that the invention was new at the date of the said letters patent.

The invention forming the subject of the said letters patent as described in the provisional specification, was intended to be applied to submarine cables, for which purpose the said invention was, and is, wholly useless and valueless. Cables constructed in accordance with the directions contained in the specification would, when laid in the sea, collapse under the pressure of the water at great depths and would be destroyed. The statement contained in paragraph 7 of the petition that cables insulated according to the invention, the subject of this petition, have been found to be of great value for telephonic purposes, is entirely untrue. No cables for telephonic work are at the present time on the market constructed in accordance with the invention, the subject matter of the said letters patent, and to the best of the opponents' belief no such cables have ever been constructed. The statement in paragraph 9 of the petition, that neither the utility of the said invention, nor the validity of the said letters patent, have ever been called in question, is only true in the sense that no owner of the said letters patent has ever ventured to assert either the utility or validity of the said letters patent, or to put the said invention in practice, by reason whereof no person has had occasion to call either the utility of the said invention, or the validity of the said letters patent in question.

The rights of the petitioning company to apply for a prolongation of the term of the said letters patent rest only on their agreement to purchase the said letters patent in November, 1894, and the assignment thereof to the petitioning company on September 9th, 1895, and it is inexpedient that parties who have thus become the assignees of letters patent at a time shortly before the expiration of the term for which the same were granted, should have granted to them a prolongation of the said letters patent on the ground that they have not received sufficient remuneration for their outlay in the purchase of the same. The fact that the letters patent was sold in the same year, once for £10 and once for £7 10s., shows clearly the value placed upon it by persons capable of judging.

The opponents submit that no grounds excusing the various owners of the said patent from putting the said alleged invention in practice are shown by the petition, nor, in fact, exist; and the opponents allege that such non-user was due to the inutility of the said alleged invention, or, alternatively, was due to the conduct of the various owners of the patent, and the negligent manner in which they carried on their business. It is not suggested in the petition, nor is it the fact, that during the period from June, 1892, until November, 1894, when the said patent was the property of James Basnett Atherton, manager and director of the petitioning company, he made any effort to put the said alleged invention in practice. If the said alleged invention was of any utility, ample opportunities existed for putting the said cable upon the market, and the failure to put the same upon the market is either strong evidence of the non-utility of the said alleged invention, or is proof that proper endeavours were not made to put the same upon the market, whereby it is inexpedient that any prolongation of the term of the said letters patent should be granted.

The opponents also refer to the fact that the annual fee for 1892 had not been paid at the proper time, and submitted that the letters patent became in consequence null and void.

The arguments against the prolongation of the patent put forward by the other opponents did not materially differ from the foregoing.

Mr. MOULTON, in addressing the Council, went somewhat minutely into the petition. He spoke of the advantages that accrued to the use of wires or cables made in accordance with the Dolbear patent. Prof. Dolbear had kept up the English patent for many years, the accounts showed no profits, and he at last sold his patent for practically nothing at all. Counsel then went into the question of the various assignments. His clients were practically the patentees, although the real patentee was Mr. Dolbear. But patents of that kind usually passed from the hands of the patentee into the hands of persons who were working it for a profit. The great advantages of an air space cable were widely recognised. Specifications in France and England were so severe with regard to the capacity of the cable on the Leyden jar effect, that they were almost obliged to have an air space cable to get them up to the standard efficiency. The specification of Dolbear was then dwelt upon at considerable length. The learned counsel then went on to deal with the arguments of the Western Electric Company. Drayson employed an insulated wire, and then put it in a tube; he had no idea of using a naked wire. He thought that he could get a higher insulation, but that was a totally different thing to capacity. By abandoning the naked wire, he lost a great deal of the advantage of Dolbear. In the second case, that of Henry Potts Scott, he appeared to have thought of reducing capacity, and had an idea of doing it by an air space; but so little did he realise the proper way of doing it, that he grooved his conductor, making it into a sort of star shape. Counsel then pointed out that, by making these grooves, he decreased the carrying power of the conductor, and, so far as common knowledge went, he would point out that this inventor used a form of conductor in which he lost more than he gained; with the same conducting power he got more capacity.

Lord Watson thought that Scott appreciated the advantage of an air space.

Mr. Moulton, speaking of the patent of W. E. Prall, said he proposed to employ a tube in which he had compressed air, considering that compressed air was a better insulator than non-compressed air. Counsel then went on to speak of the objections with regard to the American Patent Office. With reference to legal purchase, the original patentee was a petitioner as well as the British Insulated Wire Company.

Prof. Dolbear was then called and examined by Mr. Bousfield: He said he was Professor of Physics at Somerville, Massachusetts, U.S.A. Had been engaged for some years in developing this invention. Previous to that he came over to England, at which time the conduction of sound through cables was under discussion. The witness then went on to describe the sending of electrical impulses through wires for telephone work, as well as for submarine cable work. After speaking of the advantages of an air-insulated cable, he said his invention had never been employed on a submarine cable, nor could he, from his experience, say that it had been used for telephonic purposes. The witness then detailed the efforts he had made to get his new invention taken up in this country. He had seen Mr. Latimer Clark, who expressed his satisfaction with the theory of the invention. He also saw Dr. Muirhead and Professor Sylvanus Thompson and a representative of the cable department at Silvertown, and endeavoured to enlist his interest, without success. In 1892 he entered into negotiations, the result of which he was paid the sum of £10. In cross-examination, the witness admitted that air insulation was suggested before the date of his patent. He accepted £10 because it was more than he expected to get for it. An agreement was made in March, 1895, under which he was to have a fourth of the benefit of the extension of the patent. He had not derived any benefit from the use of air insulation in America.

By Sir Richard Webster: He did not know what cables had been laid by the British Insulated Wire Company in accordance with his invention.

Sir Richard Webster, interposing before the examination of the next witness, asked for evidence as to what had been done in the way of manufacturing cables.

Mr. Nisbett, the engineer-in-chief to the British Insulated Wire Company, said they had made cables enclosing an air space since 1892. Such were undoubtedly described in Dolbear's patent. They had a license to make cables under Hardingham's patent. He considered the reduction in capacity of a cable enclosing an air space as about one-fourth of the capacity of a G.P. cable. He considered Hardingham's patent suggested a method for arriving at the end which Dolbear points out as desirable. The witness was then examined on Dolbear's and Hardingham's patents. They had made two miles of cables for the G.P.O. exactly to Dolbear's drawings. He considered a cable made in accordance with fig. 8 in Hardingham's patent came within Dolbear's invention. The witness then gave the result of experiments on the capacity of various wires, which showed the superiority of a naked wire in air. The witness was then cross-examined by Mr. Cripps, who endeavoured to show that the cable made in 1892 for the G.P.O. was not in accordance with that of Dolbear. He was aware of cable being made by one of the opposing companies which would come under Dolbear's patent, in his opinion. He had not seen any patent describing a combination of air and paper insulation anterior to Dolbear's. They had made samples according to Scott's patent which gave higher capacity than rubber. The witness was further examined on Scott's and Drayson's patents.

After some discussion between Lord Watson and Counsel for the petitioner, Mr. Nisbett was re-examined on further points.

Mr. S. Z. de Ferranti, a director of the petitioning company, was next examined, and spoke of the value of an air space cable. Air space cables were very necessary at the present time, but had only become so during the past few years, owing to the prohibition of overhead wires. His company commenced to make air space cable after 1893. Mr. Cripps cross-examined closely on the question as to whether paper round a wire could be held to be a tube within the meaning of Dolbear. Witness considered the difference between the cable described in Scott's patent, and the one they were making, as very great. In the first case, the paper was practically solid with the wire.

By Sir Richard Webster: He knew of no proceedings taken under Dolbear's patents against infringers.

Evidence was given by the secretary of the British Insulated Wire Company as to the way in which the accounts of expenditure and receipts in respect of the letters patent had been made up.

Dr. Hopkinson spoke of what constituted tubes under the Dolbear process.

Mr. Moulton having said he could not carry the evidence any further, the Court was adjourned for a few minutes.

Upon the resumption of the proceedings, Lord Watson asked Mr. Moulton if he could offer any more evidence on what was done with the patent before 1892?

Mr. Moulton having replied in the negative,

Lord Watson, without calling upon the opponents, in giving judgment on behalf of their Lordships, said that Dolbear obtained a patent in 1882, which was acquired by the petitioning company, and between those two dates nothing was done in the exercise of the patent, nor towards pushing the invention commercially. During the last 18 months only had there been any attempt to exercise the patent, and the conclusion was that the petitioners had during that period probably been working under Hardingham's patent. There seemed to be no necessity for prolonging Dolbear's patent. During the 14½ years there had been no attempt to bring the invention under the notice of the public, and under those circumstances, without referring to the other grounds of opposition, their Lordships would advise that the petition ought not to be granted. They directed that the opponents should have one set of costs.

Claim by Electrical Engineers.

His Honour, Judge Lumley Smith, Q.C., on Wednesday, had before him, in the Westminster County Court, the case of Foote and Milne *v.* The Army and Navy Auxiliary Supply, Limited, which was a claim for £21 6s. 1d. for electrical fittings, &c., left with the defendant company on sale or return, and which had not been returned. £5 odd was paid into Court by the defendants.

Mr. Stephen Lynch, the plaintiffs' counsel, said the firm of Statter and Co., electrical engineers, of which plaintiffs were formerly directors, contracted with the defendant company to do all their electrical work. The firm became limited, and afterwards went into liquidation. The plaintiffs bought the present matter from the receiver, and the subject matter of the action was fittings, shades, &c., left with the defendants for the inspection of customers, and which they had not returned. Notice of the assignment of the matter to plaintiffs had been given defendants.

Mr. Foote said he was an electrical engineer, and member of the plaintiff firm. He bore out counsel's opening statement.

In further evidence it was admitted Statters had power to remove articles from defendants, but it was denied that any were removed without being replaced.

For the defence Mr. John Darch was called. He said he was surveyor of the electrical department of the defendants' stores. The agreement with Statters was that the goods should be exhibited in the showroom at the stores, but remain their property, and be left there at their risk, the defendants taking no responsibility whatever. Everything except £5 odd worth was returned to Statters.

Cross-examined: Had no books in which the articles were entered.

An Assistant in defendants' electrical department said Statters often sent for fittings.

Cross-examined: Could not say the fittings removed were not always replaced by others.

The Foreman of the department did not believe the fittings removed were always replaced.

Mr. Phillips, a clerk at the stores, said he had been through the books, and could not find any sale of the fittings in question except the £5 odd lot entered.

His Honour, after going through the items, found for the plaintiff for £8 beyond the amount paid into Court.

Clarke *v.* Julius Sax.

In the Chancery Division of the High Court of Justice on Friday, the 13th inst., this matter again came before Mr. Justice North.

Mr. Swinfen Eady, Q.C., said that he had to move for an injunction to restrain the defendant from infringing the plaintiff's registered design. His Lordship would remember it was a case with regard to lamps for electricity, and that the Court had held the design to be good, and, at the same time, that what the defendant had done was not an infringement. This was a motion in a further action, and what the plaintiff complained of now was that the defendant had not only gone much closer, but had exactly imitated the plaintiff's registered design. So close was the imitation, that the plaintiff, who was a gas engineer was unable to detect any difference between them until he had a ladder and critically examined the lamps. The facts of the case were that on February 13th, 1893, the plaintiff, Mr. Clarke, registered his design for lanterns, and on December 4th, 1895, the writ was issued in the former action, and on February 8th, 1896, his Lordship refused the motion to rectify the register, upholding the validity of the design, and on the same day refused a motion to restrain an infringement, holding that a particular lamp was not an infringement. On February 17th the plaintiff had his attention called to the fact that the defendants had proceeded to fix a new set of 34 lamps in the Metropolitan Meat Market which was an exact imitation of his registered design. Hence the motion. The learned council read a number of affidavits, and submitted that the plaintiff was entitled to the relief asked for.

Mr. Vernon Smith, Q.C., on behalf of the defendants, contended that there were substantial differences between the designs, and read evidence in support of that contention.

In the result, Mr. Justice North said he thought this was as clear and palpable case of infringement as he ever saw, having regard to his former decision. He accordingly granted an injunction to restrain the defendants from using the lamps complained of, or otherwise infringing the plaintiff's registered design.

Mr. Vernon Smith asked if his clients might be allowed to alter the lamps?

Mr. Justice North could not see his way to accede to that application, and said the defendants must be restrained from keeping the lamps there without the leave of the plaintiff.

Harvey *v.* Hill.

In the Leicester County Court the other day, Samuel Harvey, 12, Blythe Street, Nottingham, carrying on business as wood turner and carpet beater, sued Warren Hill, electrical engineer, Leicester, for £13 14s. 8d., representing a year's rent of portion of a room in Campbell Yard, a year's rent of gas engine, and half the cost of laying down larger gas pipes, and repairs to a gas engine. There was a counter-claim for £33 14s. 6d. for damage to dynamo, and loss of business in consequence of not being able to fix the necessary machinery in the room.

His Honour, in summing up, said he came to the conclusion that there was a contract of tenancy. He had to decide between the parties as to whether there was an agreement, and he was against defendant on that point. He did not consider that negligence was shown by defendant's servant in connection with the gas engine, and was not satisfied that there was an agreement by defendant to pay half the cost of the gas pipes. He therefore gave judgment for plaintiff for £24 15s., and dismissed the counter-claim.

CITY NOTES.

The National Electric Supply Company.

The accounts of this company are not only exceedingly satisfactory, but are somewhat surprising. The increase in output during 1895 has been over 50,000 units, yet the coal cost only £501 against £752 for 1894. Wages and management have been also subjected to some reductions, consequently it is not surprising that the cost of production is very low, and is the most noteworthy ever obtained by the Preston Company.

The expenditure on capital account now stands at £67,040, a sum of £2,959 having been added during the year. The mains have been considerably extended, and the demand indicator system has been employed since the commencement of the year.

The following is the analysis of the cost of production, and Mr. Tonge is to be congratulated upon bringing the costs to compare with those of the best central stations.

	1893.	1894.	1895.
Total capital invested	£59,962	£64,080	£73,235
Number of units sold	—	220,867	271,076
Number of lamps connected ...	—	—	—
Revenue from sale of current...	—	£4,619	£5,509
Total working costs	—	—	£3,338
Net revenue	—	£995	£2,401
Average price obtained per unit	—	—	4·88d.

Cost of Production.	£	s.	d.	Per unit.
Coal	501	0	0	·44d.
Oil, waste, water, and engine room stores	213	0	0	·19d.
Salaries and wages at generating station	739	0	0	·65d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	400	0	0	(Works' cost 1·63d.) ·35d.
Rates and taxes	323	0	0	·29d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	1,163	0	0	1·03d.
Depreciation of buildings and plant account .. .. Renewal fund account	400	0	0	·35d.
Total	£3,739	0	0	3·30d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	5,509	0	0	4·88d.
Meter rents, &c.	199	0	0	—
Other items	32	0	0	—
Total	£5,740	0	0	4·88d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·95d.; works' cost, 1·63d.

Hove Electric Lighting Company.

Whether it be due to the sea air, or to some still more subtle cause, it is quite evident that Brighton is a place where the electricity supply business flourishes. The Hove Company is working side by side with one of the most successful undertakings in the country, and, may be, example counts for something. At any rate it is obvious, from a perusal of the Hove Company's accounts, that they are well on the road to prosperity. Besides bringing down the cost of production, the consumption of electricity per lamp is by no means diminished, not that 8 8 units per lamp is an extravagant use of current; but then there are few stations that could even contrive to keep the consumption constant. The number of lamps has increased from 16,473 to 18,403, while the profit on the year's working stands at £2,562 against £1,243 for 1894.

We extract the following from the directors' report:—

"The directors propose to write off the sum of £134 15s. from the preliminary expenses account, to place £200 to reserve, to declare a dividend at the rate of 4 per cent. per annum on the share capital, payable on April 15th next, and to carry the balance, £152 14s. 6d. forward. The amount realised from premiums on shares, and on the 4½ per cent. debentures which were issued last year, was £460 10s.; this has also been placed to reserve fund, which will now show a credit balance of £660 10s. In accordance with the contract with the Hove Commissioners, the sum of £263 9s. 2d. has been also placed to a depreciation and maintenance reserve account. Since the date of the last report the directors have placed 1,719 shares, and £7,500 of 4½ per cent. debentures. Offers were received for the balance of the 4½ per cent. debentures at the issue price of £103, but the directors considered it advisable to place no more than the £7,500 at that time. The directors have given notice to the holders of the £12,500 of 5 per cent. debentures that they intend to pay off the same on July 1st next, and have offered to them new debentures of the company, at par bearing 4 per cent. interest in exchange. In response to the circular making this announcement, the holders of £7,250 of debentures have agreed to accept the new 4 per cent. debentures, thus leaving £5,250 to be placed, and the directors entertain no doubt of their ability to place these in July next, when the existing debentures are to be paid off. Owing to the proximity to the sphere of this company's operations of the Brighton Corporation Electric Supply Works, where the management are not under the same obligation as are the directors of a public company to work for substantial returns upon the money invested, and in consequence are able to make a low charge for their production, an adverse comparison has been made between the charges made by the Brighton Corporation and by this company. The Board, desirous of doing everything in their power to meet the wishes of their customers, have adopted as from January 1st of the present year, the method obtaining in Brighton of charging by the "demand meter" system, which regulates the rebates or discounts allowed to customers in accordance with the actual consumption calculated upon the maximum number of lamps in use at any one time. This arrangement of charging is, they consider, as fair a one as can be devised, and the directors hope that as the system offers inducements to customers, the change will result in a considerable increase during the year in the number of lamps fixed, and a corresponding increase in the consumption of current. In order to meet the increasing demand for electric current in Hove, the directors were obliged last year to add a new Crompton-Willans set of 250 horse-power, and two new boilers. With these additions to the plant, it is believed that the company will be able to meet the demands likely to arise for some time to come."

	1893.	1894.	1895.
Total capital invested	£21,700	£48,828	£54,085
Number of units sold	49,170	107,218	162,428
Number of lamps connected ...	6,915	16,473	18,403
Revenue from sale of current ...	£1,375	£3,617	£5,343
Total working costs	—	—	£2,822
Net revenue	—	£1,243	£2,562
Average price obtained per unit..	6·7d.	7·8d.	7·85d.
Revenue per 8 C.P. lamp ...	—	—	5s. 9d.
Consumption of current per 8 C.P. lamp	—	—	8·8 units
Depreciation fund account ...	—	—	£263
Reserve fund account	—	—	£461

Cost of Production.	£	s.	d.	Per unit.
Coal	709	0	0	1·04d.
Oil, waste, water, and engine room stores	191	0	0	·28d.
Salaries and wages at generating station	679	0	0	1·0d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	137	0	0	(Works' cost 2·52d.) ·20d.
Rates and taxes	191	0	0	·28d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	915	0	0	1·35d.
Depreciation of buildings and plant account .. .. Renewal fund account	263	0	0	·38d.
Total	£3,085	0	0	4·53d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	5,343	0	0	7·85d.
Meter rents	301	0	0	—
Other items	4			—
Total	£5,648	0	0	7·85d.

Total cost per unit (exclusive of depreciation and renewal accounts), 4·15d.; works' cost, 2·52d.

The Brighton Corporation Accounts.

We may have to wait many years before the majority of municipal electricity works reach the prosperous position held by the Brighton station. A municipal works may be said to have achieved something when it has become absolutely independent of the local rates to be able to apply money earned from electricity supply to the rates, is, to say the least, an admirable argument for the extension of municipal enterprise. It is very evident, as we have remarked elsewhere, that the inhabitants of Brighton are distinctly favourable to the use of electricity. Nor is it the habits of the well-to-do classes

that alone contribute to the success of the electricity works, for we understand that many of the best customers reside in the comparatively poor neighbourhoods. There is little doubt that the system of charging has been, to a great extent, responsible for the progress made by the electricity works; but a good deal must be due to the excellent management of Mr. Arthur Wright.

	1893.	1894.	1895.
Total capital invested	£78,541	£119,382	£151,543
Number of units sold	286,900	583,701	867,494
Number of lamps connected ...	17,000	38,000	—
Revenue from sale of current...	£7,393	£15,298	£17,607
Total working costs	—	—	£8,537
Net revenue	—	—	£8,927
Average price obtained per unit	—	4·5d.	4·86d.
Reserve fund account	—	—	£4,148

Cost of production.	£	s.	d.	Per unit.
Coal	2,596	0	0	·72d.
Oil, waste, water and engine room stores	532	0	0	·15d.
Salaries and wages at generating station	1,719	0	0	·47d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,293	0	0	(Works' cost 1·69d.) ·35d.
Rates and taxes	317	0	0	·09d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	2,080	0	0	·59d.
Depreciation of buildings and plant account	—			—
Sinking fund account	4,147	0	0	1·14d.
Total	£12,684	0	0	3·51d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	17,607	0	0	—
Meter rents	487	0	0	4·86d.
Sale of Lamps	—			—
Total	£18,094	0	0	4·86d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·37d.; works' cost, 1·69d.

Burton-on-Trent Corporation Accounts.

When we had the pleasure of reviewing the Burton accounts last year, we were driven to the melancholy conclusion that they established the highest record for cost of production. 1895 has come and gone, and leaves the Burton system with 12 customers more than were connected at the end of 1894. An accession of one customer per month is not calculated to fill the soul of the Burton engineer with joy. The system was started on February, 1894, with 13 customers; at the end of December, 1894, there were 52 customers; and at the end of 1895 the number had been swelled to 64. But, in spite of the mildness of Burton in taking up electricity for domestic and other purposes, there is no reason to despair. For one thing, the revenue is not quite so microscopic as that obtained during 1894. It now stands at £1,002, while it was previously £482; and, considering that the working costs have increased by only £444, it is reasonable to assume that with the accession of more consumers, the electricity works would soon give evidence of turning the corner. It is difficult to give a recipe for the securing of customers; perhaps a house-to-house visitation might avail to some extent, but whether the results would be commensurate with the efforts put forth is difficult to say.

The cost of production analysed is as follows:—

	1893.	1894.	1895.
Total capital invested ...	—	£27,000	£28,634
Number of units sold	—	19,291	40,094
Number of lamps connected ...	—	—	—
Revenue from sale of current...	—	£482	£1,002
Total working costs	—	—	£1,287
Net revenue	—	—	nil.
Average price obtained per unit	—	5·	5·7d.

Cost of production.	£	s.	d.	Per unit.
Coal	222	0	0	1·33d.
Oil, waste, water, and engine room stores	90	0	0	·54d.
Salaries and wages at generating station	789	0	0	4·72d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	45	0	0	(Works' cost 6·86d.) ·27d.
Rates and taxes	70	0	0	·42d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	71	0	0	·42d.
Depreciation of buildings and plant account	—			—
Renewal fund account	—			—
Total	£1,287	0	0	7·70d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	1,002	0	0	5·7d.
Meter rents	47	0	0	—
Other items..	1	0	0	—
Total	£1,050	0	0	5·7d.

Total cost per unit (exclusive of depreciation and renewal accounts), 7·70d.; works' cost, 6·86d.

Dover Electricity Supply Company, Limited.

It would be unfair to examine too closely the accounts of the Dover Electricity Supply Company recently issued. In the first place, the result of nine months only is recorded, and in the second the period included the summer months, so that altogether it is difficult to forsee what a full year's work would reveal. A statement in the directors' report that deserves some prominence is that in December, the revenue about balanced expenditure. There has been naturally a considerable loss on the nine months' working, but not a hopeless one, and with the recent lowering of price there ought to be a considerable accession of consumers. The rates now charged are 7d. per unit for currents consumed up to 12 units per annum for each 8-C.P. lamp, and to charge 5d. per unit for all current used in excess of such consumption, as well as for electric heating and power purposes. We note from the report that the street lighting is giving satisfaction. At this early stage of the company's operations the following analysis will only have a value when compared with the future years' work.

The following table gives the cost per unit:—

	1893.	1894.	1895.
Total capital invested ...	—	—	£49,268
Number of units sold	—	—	56,658
Number of lamps connected ...	—	—	4,125
Revenue from sale of current...	—	—	£1,004
Total working costs	—	—	£2,079
Net revenue	—	—	
Average price obtained per unit	—	—	4·25d.
Revenue per 8-C.P. lamp ...	—	—	4s. 10d.
Consumption of current per 8-C.P. lamp	—	—	13·7 units.

Dr. Cost of Production.	£	s.	d.	Per unit.
Coal	540	0	0	2·29d.
Oil, waste, water, and engine room stores	144	0	0	·61d.
Salaries and wages at generating station	432	0	0	1·83d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	94	0	0	(Works' cost 5·13d.) ·40d.
Rates and taxes	39	0	0	·16d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	830	0	0	3·51d.
Depreciation of buildings and plant account	—			—
Renewal fund account	—			—
Total	£2,079	0	0	8·80d.

Cr. Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	1,004	0	0	—
Meter rents	27	0	0	4·25d.
Other items	92	0	0	—
Total	£1,123	0	0	4·25d.

Balance against ... ... £955.

Total cost per unit (exclusive of depreciation and renewal accounts), 8·80d.; works' cost, 5·13d.

The Oxford Electric Company, Limited.

The ordinary general meeting of the shareholders of the Oxford Electric Company, Limited, was held at the offices of the company, 45, Broad Street, Oxford, on Friday, March 6th, Sir Henry C. Mance in the chair.

The Secretary (Mr. Harry Eeles) having read the notice convening the meeting,

The Chairman said he trusted the shareholders would agree with him that the report and accounts for the year 1895 were of an extremely satisfactory character. The capital expenditure for 1895 amounted to £6,268 4s. 6d. The amount expended on buildings, £116 15s. 4d., included expenses incurred in constructing a new transformer house at Brasenose College, preparing buildings at North Parade Avenue as a sub-station, and sundry additions and improvements at the works. The two new sub-stations were rendered necessary by the gratifying increase in the demand for current in the respective neighbourhoods in which they are situated. They had had to add another engine and dynamo, of the latest and most approved type, to cope with the demand during the winter of 1895. The cost of the new dynamo and transformer required for Brasenose sub-station was included in the item of £1,100. The expenditure for public lamps was due to the increase in public lighting. The expenditure on mains had been necessary for important extensions in the north of Oxford, Canterbury Road, Rawlinson Road, Norham Gardens and Bardwell Road. In the city extensions had been made in St. Ebbe Street, High Street, New Inn Hall Street, New Road, and George Street. A very considerable portion of this expenditure upon mains had been due to the new scheme of public lighting referred to in the report. There had also been taken from the trunk mains about 60 services for various consumers. The other items of capital expenditure were inconsiderable, with the exception of meters. This had been rendered necessary by the satisfactory increase in the number of consumers. The more consumers they had, of course, the more meters were required. On the other hand, they sold more current, and also got a reasonable return for expenditure under this head in the shape of rentals paid for the meters. Passing to the credit side of the capital account, the debenture issue was practically the same as last year, but they had received a further instalment of loan capital to the extent of £4,342 13s., the whole of which had been used to pay for capital works. When the cost of the new public lighting scheme and other expenditure on capital account was provided for, the whole of the £10,000 loan arranged for last year would have been more than expended. In order, therefore, to provide for this and other extensions and additions to plant during 1896, they would note by the report that the directors proposed to issue 914 ordinary shares of £5 each. This would bring the number of ordinary shares issued up to 7,500. The directors were anxious that the public of Oxford should become interested in an enterprise which it must be allowed had added to the attractiveness of the city. They, therefore, had decided to give local applications a preference in allotment. The expenses of generating amounted during the year 1895 to £1,472 16s. This compared very favourably with the results attained last year, the expenditure on coals having been reduced to ·55 of a penny per unit delivered to consumers. The maintenance charges they would notice amounted to £338 9s. 8d. It had been their policy to maintain the plant in thoroughly efficient order, allowing each year to bear its own expenses in this respect, thereby doing away with the necessity of creating a depreciation fund. Passing to the credit side of the revenue account, the increase in the amount of current sold was £1,464. This was the best evidence they could offer of substantial progress. The rentals received for meters was less in consequence of the great reduction that had been made in the charges for these instruments. There had been a small profit made upon the putting up installations, the charging of launches, &c. The gross profit amounted to £2,709 8s. 3d., which had been carried to the net revenue account. The balance brought from the last account amounted to £524 11s. 3d., and after paying the dividend, the net amount carried forward was £195 4s. 8d. Thus, after meeting the debenture interest, and the interest upon loan capital, there remained a balance of £1,512 14s., and out of this they recommended a dividend at the rate of 3½ per cent., carrying forward £360 3s. In the balance-sheet, the sundry creditors were, for the most part, contractors for capital works completed and in progress, and the same remark applied to the creditors for bills payable. With regard to the item "Sundry debtors," the greater part of the amount was composed of the Christmas quarter's revenue, most of which was collected early in January. The stock on hand consisted chiefly of cable, coals, and other stores, most of which would be utilised almost immediately in completing capital works now in progress. The commercial efficiency of their system was improved, being now about 70 per cent. The number of their customers had increased during the year from 154 to 225. The more important of the 67 additions to the list of customers were Balliol College, Somerville Hall, additional lights in Exeter College, and the important installations of Messrs. Elliston and Cavell, the new Municipal Buildings and the Corn Exchange. The system of supply to the public lamps had been almost entirely altered. All the half-night lamps are now connected in series. Additions to the circuit, and the change from one system to the other were effected by Mr. MacLean, the managing engineer, without the slightest interference to the service. These half-night lamps were extinguished simultaneously. The all night arc lamps still remained connected with the low-tension mains, and by means of Mr. McLean's device cut themselves off automatically at the appointed hour in the morning. When the half-night lamps were suppressed, that is to say, about midnight, each arc was replaced by two incandescent lamps, which were supported on subsidiary brackets on the same poste. He had every confidence that the new public lighting contract would give even greater satisfaction to the Oxford public than the old one. It was very gratifying that the forecast he made at the last annual meeting had been closely borne out in the results of the year's working. He anticipated they should reach an equivalent to about 15,000 8-C.P. lamps As a matter of fact, they had a few lamps in excess of this number connected to the system January 1st. He had every reason to anticipate that the increase in the number of lamps during 1896 would be quite as encouraging as during the past year, and while on the other hand this meant increased revenue, and he trusted still better dividends, it was equally obvious that the increased demand required that they should supplement their means of production with additional plant. As business men, they did not consider it prudent to rest content unless the machinery was capable of meeting all the demands for current with a fair reserve of power to provide against accident. It was their pride and boast that they had never broken faith with the Oxford public. The supply of current had been continuous day and night since they first started. Their engineer had now under careful consideration plans and estimates which were intended to provide for possible requirements during the next three years. He did not know of any electric light company whose capital account had yet approached finality, but for these extensions which they would be called upon to make it would be necessary to provide additional capital. It was mentioned in the report the intention of offering 914 shares for public subscription. Bearing in mind the fact that the value of money for the purpose of investment seemed to be gradually approaching the vanishing point, he had not the slightest doubt that the merits of this investment would be appreciated by the Oxford public. With regard to the loans outstanding, they did not propose disturbing them at present. In conclusion, he said he had the highest opinion as to the future of the company. He believed that they had a prosperous career before them, and moved "That the report and accounts be adopted, and that the recommendations therein contained be approved."

Alderman Buckell seconded the motion.

The report and accounts were then adopted. After the retiring directors had been re-elected, a vote of thanks was accorded to the staff, and with the usual vote of thanks to the chairman, the meeting terminated.

The Direct Spanish Telegraph Company, Limited.

The report and accounts of the directors for the year ended December 31st, 1895, to be presented at the yearly general meeting of shareholders, to be held on Tuesday, March 24th, 1896, states:—The accounts for the year ended December 31st, 1895, show a balance to the credit of revenue of £13,239 12s. 9d. After providing for interest on and redemption of debentures, and adding £5,000 to the reserve fund, the balance of revenue amounts to £5,801 6s. 9d., and the directors recommend the declaration of dividends for the year 1895 of 10 per cent. on the preference shares, and 4 per cent., free of income-tax, on the ordinary shares, absorbing £5,486 4s.; half of this amount was distributed on October 1st, 1895, as an interim dividend in respect of the half-year ended June 30th, 1895. A balance of £315 2s. 9d. will remain to be carried forward to the next account. The reserve fund will then amount to £28,498 8s. 8d. The traffic receipts show an increase of £4,571 14s. 6d., as compared with the year 1894. The ordinary working expenses are £238 4s. 11d. in excess of those for the year 1894. The company's cables, and the landlines in connection with them, have continued in good working order throughout the year. The directors regret the loss the company has sustained by the death, on June 6th, 1895, of Senor Don José Aparicio, who had been the highly valued representative of the company in Spain since its formation. Senor Don Vicente Coromina has been appointed his successor. Mr. Edmund Etlinger and Mr. J. Denison Pender are the directors retiring by rotation, and offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and offer themselves for re-election.

Messrs. W. T. Henley's Telegraph Works Company, Limited.

The ordinary general meeting was held on Friday last at the offices, Martin's Lane, Cannon Street.

Mr. Sydney Gedge, M.P., presided, and, in moving the adoption of the report, congratulated them on its very satisfactory character. In their past history they had had to meet and say that the dividends they were looking forward to were still in the future, but that time had now passed. They began by paying 5 per cent, which was increased to 6 per cent., and they now recommended a distribution of 8 per cent., while the profits would have enabled them to pay 10 per cent. or 12 per cent. They had transferred £5,000 to the reserve fund, instead of £2,180 last year, and they had written off for depreciation £1,964, instead of £1,000. They had also expended about twice as much as usual on the maintenance of their works, which were now in first-rate condition. Their volume of sales had increased by nearly 47 per cent. compared with those of the previous year, and this had not been owing by any means to any large submarine cable work giving them a large profit, but by the steady growth of their general business. The balance of profit and loss account was £18,942, which was increased by the balance brought forward to £27,567. As he had said, they could have recommended a larger dividend, but, after full consideration, the board came to the conclusion that it would be far more to the interests of the shareholders individually, and to the company as a whole, to strengthen the reserve fund by the amount he had mentioned, and to carry forward a large balance—£13,367. The amount owing by the company was £17,525, while the amount due to them exceeded that sum by £42,841, whereas

he saw by the balance-sheet of another similar company—a very strong company—that the latter owed £145,000 more than was due to them. The gross profit on the trading of the company last year was £36,967, which had been earned at an expense, including directors' fees, of £14,176, or about 38 per cent. In the case of another company he saw that their gross profit was £134,930, which was earned at an expense of £64,695, or about 48 per cent., and, as the shareholders were aware, the larger the gross profits the smaller the percentage of fixed charges. He therefore believed that the board would be commended for their economical management. The capital of the company was £100,000 in ordinary shares and £30,000 in preference shares bearing 7 per cent., but the holders of the latter had the option up to July 2nd next of giving six months' notice to convert them into ordinary shares. He believed that the conversion would prove advantageous to the preference shareholders, while it would certainly be beneficial to the company should they ever require, by the extension of their business, to raise further capital by preference shares. He afterwards referred hopefully to the company's prospects.

Major-General George Hutchinson seconded the motion, which was unanimously adopted, and the dividends recommended were declared.

Eastbourne Electric Light Company, Limited.

The annual meeting was held on Monday, at the Clifton Hotel, Eastbourne. Mr. J. G. Langham, who was voted to the chair, expressed regret at the absence of Mr. George Boulton, the chairman of the directors, owing to ill health, and moved a vote of sympathy with him and Mrs. Boulton. This was carried. The chairman, in moving the adoption of the report and accounts for the year ending December 31st last, congratulated the company on the business done. There had been an increase during the year of two arc lamps and 2,150 incandescents, making the total lights in circuit 37 arc, and 14,206 incandescents for terms of 8-C.P. The revenue account showed a gross profit of £3,182 2s., and after adding £400 to the depreciation fund, and paying debenture and other interest, they had £1,656 available for dividend. Last year they started a reserve fund with £300. To this they proposed to add another £300, making £600, and there would be enough, not only to pay a dividend of 7½ per cent., the same as last year, which would absorb £798 15s., but to carry forward £557 5s. Last year the balance carried forward was £441. With the £400 added this year, their depreciation fund amounted to £2,225, in case of the wearing out of cables, &c. They had laid a new boiler in during the year, but regarding it as an addition to their plant—a necessary addition, in consequence of the increased demand for the electric light—they would charge it to capital. Dilating upon the history of the company since its incorporation in 1882, the chairman said that the receipts in each successive year had been as follows:—£1,140, £1,912, £2,611 (two years), £2,173, £3,497, £4,053, £4,539, £6,753 (a year and a quarter), £4,549, £5,216, £5,910, £6,713. These figures showed, he considered, that they had not only a going, but a growing concern. In 1892 they paid their first dividend 3 per cent., in 1893 they paid 5 per cent., in 1894 they paid 7½ per cent., and this year they were in a position to pay the same amount. At present there were no less than 16 miles of pipes, laid down in 11¼ miles of streets in Eastbourne, and there were 11¼ miles of double cable, and 3½ miles of single cable, making a total of 26 miles of cable in the town.

Alderman Sutton seconded the motion, which was carried.

It was unanimously resolved that the directors' remuneration for the past year should be the same, namely, £200, as in the year preceding.

The Chairman intimated, with regret, that Alderman Sutton, who retired from the directorate by rotation, declined to stand again, owing to pressure of private business. Having been a member of the board since the formation of the company 14 years ago, he could appreciate the valuable services of Alderman Sutton.

Although it seemed to be the unanimous wish of the meeting that he should continue a member of the board, Alderman Sutton said his decision was final, as he could not find the time, and on his proposal, seconded by Mr. Hurst, Mr. Hollins was elected to the vacancy, a vote of thanks being passed to Alderman Sutton for his past services.

The auditors, Messrs. Hart Bros., Tibbets & Co., were re-elected.

Birmingham Electric Supply Company, Limited.

The annual general meeting of this company was held at the offices of the company, Dale End, on the 11th inst., Mr. Henry Buckley presiding.

The Chairman, in moving the adoption of the report, said the directors were thoroughly satisfied with the position of the company, and he also took it that the shareholders were satisfied with the position, too. The quotations in the papers of the price of their shares were sufficient guarantee of the success of the company. When it was impossible to buy at 6⅝, it showed that those who had shares were holding them. The new capital of £50,000 recently issued, was issued at a cost of under £50, and present shareholders applied for more than double the amount of shares than were issued. The reserve fund had been materially strengthened, and the firm position of the shares was due largely to that reserve. If they had paid away all their earnings instead of putting it to reserve, the shares would not have stood so well as they did. The policy pursued in regard to the reduction of price had also justified itself; the loss of revenue had been more than balanced by increased consumption. From the returns of January and February they were justified in thinking that the volume of trade this year would be larger than ever. They were getting fresh custom and increased consumption by present consumers. Unfortunately the new district of Edgbaston was only properly laid in November, and the jewellery quarter in January. This arose from an accident by fire which destroyed one of the largest electrical engineering works in the country when their company had a quantity of machinery there ready to deliver. That accident caused them considerable discomfort, and he paid a high tribute to the work of their managing director, Mr. Vaudrey, during a period of exceptional anxiety.

Colonel Wilkinson seconded the motion for the adoption of the report, and characterised the reduction of the price as a wise policy. They wanted to convince the public that electric light was something more than a luxury.

Mr. Buckley and Mr. F. W. V. Mitchell were re-elected to the directorate, and Messrs. Sharp, Parsons & Co. auditors, at an increased fee.

A dividend at the rate of 4 per cent. was declared, and the meeting terminated.

Isle-of-Man Electric Tramway Company.—At an extraordinary general meeting, held on Wednesday, the resolution to purchase the Snaefell Mountain Railway for £72,500 was unanimously confirmed, and it was also decided that the capital of the company should be increased to £175,000 by the creation of 25,000 new £1 preference shares.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending March 15th, 1896, were £949; week ending March 17th, 1895, £912; increase, £37; total receipts for half-year, 1896, £10,786; corresponding period, 1895, £10,823; decrease, £37.

The Liverpool Overhead Railway Company. The receipts for the week ending March 15th, 1896, amounted to £1,095; corresponding week last year, £975; increase, £120.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 13th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,805.

NOTES.

Seeing Through the Body.—The interesting telegram from Mr. Edison to Lord Kelvin, which will be found on page 374 of our Correspondence columns, evidently refers to the published statements in the daily papers that Mr. Edison professes, according to a Dalziel's despatch, to have discovered a chemical substance which enables the Röntgen shadows to be seen directly by the naked eye, with the result that the physician may soon be able to study his patient alive as he now does at an autopsy. In practice the patient would stand between the apparatus and a screen, out of sight of the physician so far as the ordinary light is concerned, but his skeleton would be revealed on the crystal side of the screen, and the fat and muscles would be indicated by variations in the density of the shadows. Physicians will, Mr. Edison asserts, be able even to trace the presence of consumption, because of the difference in solidity shown by the diseased and healthy parts of the lung. Mr. Edison, however, is not the first to accomplish this result, for what he claims to be able to do has already been done by at least two investigators, probably others, in London.

Royal Institution.—We are informed that the lecture arrangements after Easter include discourses by Professor Sylvanus P. Thompson, Professor J. A. Ewing, Professor J. A. Fleming and other gentlemen.

The Institution of Electrical Engineers.—On Thursday, March 26th, 1896, a paper on "Telephone Exchanges and their Working" will be read by Dane Sinclair—member.

The Three-Wire System.—The Whitehaven Council is to oppose the three-wire system patent renewal.

Sullivan's Universal Galvanometer. — Some four months ago we published a letter from Mr. John Rymer-Jones, detailing the manifold merits of the Sullivan galvanometer, which was described and illustrated in our issue of March 22nd, 1895. The inventor has quite recently received further testimony as to the superiority of his galvanometer over all others from Mr. George Keith, of the Cuba Submarine Telegraph Company, and Mr. E. Raymond-Barker, of the India-Rubber and Gutta-Percha Company, Silvertown. From observations during the laying of the Cuban Coast cables, Mr. Keith states that the instrument was practically unaffected by the ship's movements, was very sensitive, dead beat, and that accurate tests could be rapidly taken with it in all weathers; in fact, he considers it invaluable. Mr. Raymond-Barker corroborates all that Mr. Keith says, and adds that the qualities of the galvanometer as a time saver should be specially mentioned. Its constancy of zero, not only with changes in the ship's course, but also under the numerous outside magnetic disturbances common on board ship, which so affect the working of the old marine galvanometer, is one of its most remarkable features. It gives us pleasure to add our own testimony to that of others, based on personal experiences within the past month, to the extraordinary virtues of Sullivan's apparatus. The electrician of one of the numerous cable companies, with an experience of nearly a quarter of a century, considers it by far the best galvanometer he has seen.

The Institution of Junior Engineers.—On Saturday, March 28th, 7.30—11.30 p.m., at the Westminster Palace Hotel, London, the conversazione in connection with this Institution will take place. The programme is somewhat elaborate. There will be a number of exhibits relating to engineering work, and some very attractive items are being prepared in the new photography, the operation of the crytograph being shown. Mr. R. W. Paul will give demonstrations on the theatrograph, Mr. Wimshurst will show experiments on Wimshurst machines, Mr. Reg. Wallis-Jones will exhibit his electric welding operations, Mr. Lynd will operate the phonograph, and there will be electric cooking and various other interesting features.

Fires.—A fire occurred last Friday morning at Sedburgh Mills, Shaw Hill, Halifax, and damage estimated at £1,000 was done. The fire originated in a room occupied by the Northern Electric Wire Company, and spread to the first and third rooms, in the occupation of Messrs. George Patchett & Sons, wire manufacturers.

On Saturday night last, a small fire occurred at the Westow Hill sub-station of the Crystal Palace District Electric Supply Company, through the breakdown of one of the armatures of the motor-dynamo. No inconvenience was suffered by consumers.

Perhaps this is American Humour.—The electro-therapeutic department of the *Electrical Journal* of Chicago seems easily filled. It contains the article from our issue of February 14th: "Disintegration of Organic Tissue by High Tension Discharges," but without a word of acknowledgment. No doubt it is due to an oversight.

Accidents Due to Gas.—A gas explosion at 29, Russell Street, Stockton, blew Mrs. Shields through the window into the street, where she rolled over several times, but sustained very little injury. The explosion set fire to curtains and other inflammable material in the room.

At a coffee-house in Old Ford Road, Bow, a gas explosion occurred on 12th inst., the premises being considerably damaged.

The Northern Society of Electrical Engineers.—At the Palatine Hotel, Hunt's Bank, Manchester, on Monday, March 23rd, 1896, a paper will be read on "The Regulation of Pressure and the Reduction of Light Load Losses in Alternating Current Systems of Electric Light," by E. W. Cowan, Member of Council and A. Still, member.

Newspaper Science. — Our contemporary, *Answers*, although full of interesting matter, and a paper which enables travellers to while away many a weary hour when on tour, is in want of a scientific editor, if we may judge from the following effusion, which appeared in a recent issue:—

> Perhaps the greatest of all mysteries, to the uninitiated, about telegraphy, is the fact that when a wire is broken or damaged, say between London and Birmingham, or between England and Ireland, the operator, sitting in his office, can tell exactly where the accident has occurred.
>
> The explanation, however, is very simple. It requires force to send electricity through a wire, just as it does to pump water through a hose. The longer the wire is the greater is the force required. This force is measured; but, instead of calling it pounds, as in measuring the pressure in a boiler, electricians call the units of electrical force "ohms."
>
> Suppose a wire between two offices is 150 miles long, and that, on a stormy night, it gets broken somewhere. The telegraphist knows that when the wire was sound it took just 2,000 ohms to send a current through, or 14 ohms per mile. He now finds that he can send a current with only 700 ohms. He divides 700 by 14, and finds that the break in the wire is 50 miles from his end.
>
> When the wire is under the sea a curious thing happens. The electricity decomposes the sea-salt, and a new salt is formed on the broken ends of the wire; and until that is cleared away by what is called a zinc current, acting for 10 or 12 hours, no measurement can be made.

The confusion in the mind of the writer as to electrical terms is characteristic of newspaper science. As a matter of fact, we may mention that the general idea that electrical measurements of the nature quoted are made for the purpose of localising faults on the English postal lines is an erroneous one; tests of the kind are really very rarely indeed made. The lines are divided into test sections, and what is actually done when, say, an earth fault occurs is for the terminal office to ask each test office on the route in turn to disconnect the faulty wire; a simple test with a battery and galvanometer being made each time from the terminal office. When on making the test the fault is found to have disappeared, then it is obvious that the fault lies in the last section cut out; the lineman in charge of that section is then advised, and he walks over the section until he arrives at the fault, and removes it.

Electric Heating in the States.—After six months of negotiation the absorption of all the important electric heating companies has been effected by the American Electric Heating Corporation, Sears Building, Boston, and the control of the new consolidation will pass into the hands of a syndicate composed of well-known persons. The concerns absorbed by the American company are: The Western Electric Heating Company, St. Paul, Minn.; The Central Electric Heating Company, New York; The New England Electric Heating Company; The Burton Electric Company, Richmond, Va.; The Carpenter Electric Heat Manufacturing Company, St. Paul, Minn.; The Dewey Electric Heating Company, Syracuse, N.Y.; The Rich Electric Heating Company, Mt. Vernon, N.Y., as well as several others which have not been active in the business for some time, but which owned valuable patents. Heating by electricity, states an American exchange, is now a commercial success, and in addition to the large number of patents now owned by the American Corporation, it also owns the patents covering the enamel process, which has already proved of great value in rheostats, and it is believed will be of equal importance in many other devices. The policy of this company is to furnish the best that the state of the art will permit, and they are provided with an able corps of practical men and ample capital to ensure this. The manufacturing will be concentrated at Cambridgeport, and the head office is at 611, Sears Building, with agencies in New York and Chicago.

The Royal Society.—Before this Society, yesterday afternoon, the following papers were read: "Helium, a Gaseous Constituent of certain Minerals—Density, Part II.," by Professor W. Ramsay, F.R.S.; "On the Reflection of Röntgen Light from Polished Speculum Metal Mirrors," by Lord Blythswood; "On the Effect of the Röntgen X Rays on the Contact Electricity of Metals," by J. R. Erskine Murray; "The Effect of Röntgen's Rays on Cloudy Condensation," by C. T. R. Wilson.

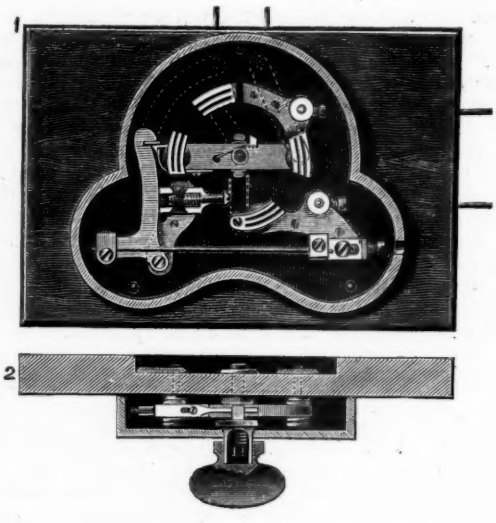
Coal Handling for Steam Generation.—At the meeting of the Institution of Junior Engineers, held at the Westminster Palace Hotel, on March 6th, Mr. H. J. Young in the chair, the paper read was on "Coal Handling Plants for Steam Generation," by Mr. Charles H. Fletcher, member. The subject, the author stated, had received but little attention at the hands of English engineers, but, owing mainly to the exertions of Mr. C. W. Hunt, of New York, its importance had been fully recognised in the United States, where many applications of special plants had been installed. Descriptions were given of appliances used for hoisting, carrying, and delivering the coal consumed in the generation of steam at various large power and locomotive coaling stations, a number of lantern slides being used in illustration. In the past, the expense of handling coal and ashes had been regarded as a minor one, but, through the more exact knowledge of thermo-dynamics and the perfection of modern steam raising appliances, the saving it had become possible to make in this direction had become relatively more prominent, so much so, that in some cases the buildings, boilers, and coal storage had been specially arranged to decrease the daily operating expenses to the smallest possible amount. One installation referred to was that at the Third District Station of the Edison Electric Illuminating Company, of Brooklyn, where the work to be done was to take the coal from waggons, carry it to storage bins above the boilers, weigh it, deliver it to the furnaces, and to remove and dispose of the ashes. The coal is dumped into a hopper under the side walk, from whence it passes through a filler into a conveyer, consisting of a series of buckets pivoted in a double chain, the whole system being carried on self-lubricating wheels running on a track, changes of direction being made by running around curves; this, together with the driving, being effected by pawls rolling on pins in the chain, entirely doing away with sprocket wheels, and the wear and noise inherent to them. The driver was operated by an electric motor, but other methods, such as a rope drive, leather belting, and directly connected engines, were illustrated and described as suitable. The ashes were removed by the coal conveyer, a separate rotary filler delivering a measured quantity of ashes to each bucket.

Leather Belt Cross Section Needed.—This useful table, published by the *Scientific American*, shows what area of cross section of leather belt is needed to give various horse-powers, with various arcs of contact on cast-iron pulleys, at a belt speed of 3,000 feet per minute, the fastenings being single leather lacings. From it, having decided on the thickness, the width may be determined, or *vice versa*, by simple division.

Arc.	Horse-powers.									
	5	10	15	20	25	30	35	40	45	50
Deg.	Sq. in.	Sq. in.	Sq. in.	Sq. in.	Sq. in.	Sq. in.	Sq. in.	Sq. in.	Sq. in.	Sq. in.
30	0·90	1·79	2·68	3·58	4·48	5·37	6·27	7·16	8·06	8·95
45	0·63	1·26	1·88	2·51	3·14	3·77	4·40	5·02	5·65	6·28
60	0·49	0·99	1·48	1·98	2·47	2·96	3·46	3·95	4·45	4·94
75	0·41	0·83	1·24	1·64	2·07	2·49	2·90	3·28	3·73	4·14
90	0·36	0·73	1·09	1·45	1·82	2·17	2·55	2·91	3·26	3·64
105	0·33	0·65	0·98	1·31	1·63	1·96	2·29	2·61	2·94	3·27
120	0·30	0·60	0·90	1·20	1·50	1·80	2·10	2·40	2·70	2·99
135	0·28	0·56	0·83	1·11	1·39	1·67	1·94	2·22	2·50	2·78
150	0·26	0·52	0·78	1·04	1·30	1·56	1·82	2·09	2·35	2·61
165	0·25	0·50	0·75	0·99	1·44	1·49	1·74	1·99	2·24	2·49
180	0·24	0·47	0·71	0·95	1·20	1·42	1·62	1·90	2·13	2·37
195	0·23	0·46	0·68	0·91	1·14	1·37	1·60	1·83	2·05	2·28
210	0·22	0·44	0·66	0·88	1·10	1·32	1·54	1·76	1·98	2·20
240	0·21	0·42	0·62	0·84	1·05	1·25	1·46	1·68	1·87	2·09
270	0·20	0·40	0·60	0·80	0·99	1·20	1·49	1·60	1·80	1·99
300	0·19	0·39	0·58	0·77	0·97	1·16	1·35	1·54	1·74	1·93

Fatal Electric Shocks.—A transatlantic exchange records an instance of father and son being killed by electric shock at Providence, R.I., last month. An old broken telephone wire which hung from a pole was thrown out of the way of pedestrians. It crossed an electric wire, and became charged with current. A man named Tracey attempted to remove the wire, and immediately he took hold of it he became rigid, and fell. His son, who went to the rescue, in trying to remove the wire, also received a fatal shock.

An Improved Electric Switch.—The illustration, which we take from the *Scientific American*, represents a simple and effective switch which may be used as an ordinary switch and also as a cut-out for preventing the passage of an excessive current to a particular portion of the circuit. Fig. 1 represents a vertical and fig. 2 a horizontal section of the switch, whose base is of insulating material, recessed at the back to receive the electrical connections, while a cover fits over the working parts. On a stud projecting from the base is



fulcrumed a spring-actuated switch arm adapted to be engaged by a detent lever, while a spring tends to disengage the detent lever from the arm. An expansion wire, used as a conductor, is arranged to normally hold the detent lever in engagement with the switch arm, but releases the lever when the wire is expanded by heat due to excessive current. A key, having a fork loosely embracing the lever, has a thumb-piece outside the cover, whereby the switch arm may be released from the detent lever and turned by hand.

Electricity as an Economical Motive Power.—The last issue of the *Trade Journal's Review* contains reference to a special instance of the economy of electricity as a means of power in connection with mining engineering. In a recent lecture at Mason's College, Birmingham, Mr. Meachen referred to the electrical plant at Haden Hill Colliery, which has been at work six months. The total cost of the installation was £2,289. A steam plant would have cost less by £1,089; but with the electric plant there was the additional advantage of light, and this saved £73 per annum in candles, and effected a further saving of £30 per annum in lights on the bank. Altogether, it appeared, there was a saving of £102 a year. Taking other considerations into account, the net gain by using electricity in place of steam was equal to 3¾d. per ton, or on the total output £40 per week. The labour cost in connection with the installation was ·47d. per ton. This statement does not break the record, says our contemporary; but it commends itself by its moderation, and if its accuracy in all particulars can be fairly proved, we may expect to see quite a revolution in the application of power to all kinds of machinery.

Lectures, &c.—At the meeting of the North-East Coast Institution of Engineers and Shipbuilders to-night, at Sunderland, Mr. A. E. Doxford, B.A. Cantab., will read a paper on "Balancing High Speed Engines."

At Toynbee Hall, last Saturday night, Prof. D. S. Capper lectured on "Water Power and its Applications." The lecture was illustrated by lantern views. Special attention was given to the utilisation of the Niagara Falls.

At a recent meeting of the Galashiel's Farmers' Club, a paper was read by Mr. Thomas Symington, on "The Relation of Horseless Carriages to Agriculture."

Prof. J. A. Fleming lectured at the Corn Exchange, Newark, on 9th inst., on "Magnets and Electric Currents."

Petroleum for Autocar Propulsion.—It is proposed that the Select Committee on the law relating to petroleum shall comprise 13 members—Sir Thomas Carmichael, Mr. Jesse Collings, Mr. Alexander Cross, Mr. Daly, Mr. Flannery, Sir Edward Hill, Mr. Holland, Mr. Wootton Isaacson, Mr. Kenyon, Mr. Mundella, Mr. Harold Reckitt, Mr. Compton Rickett, and Sir Benjamin Stone. When last empanelled, the Committee practically confined their inquiry to petroleum as an illuminant, and the means for preventing the sale of dangerous lamps. On the present occasion, however, they will be directed to turn their attention to the uses to which inflammable liquids can be applied, especially in the propulsion of locomotives. A correspondent of the *Autocar* says: "I have noticed with surprise the large number of engines using light oils, such as benzoline, &c., and knowing what a dangerous oil this is, even when used by experienced persons, I begin to wonder what the result will be when it is placed in the hands of the hundreds—I may say thousands—of unskilled persons who will be called upon to attend to and re-fill the oil receivers, and keep in order these machines. We painfully know what a large number of deaths are brought about by the use of ordinary petroleum in domestic lamps; how many then are we to expect from the use of an oil which is, at least, 10 times as dangerous?"

Electrical Engineering in Russia.—A company has recently been formed to be known as the Nicolaieff Shipbuilding and Iron Foundry Company, to establish an iron foundry and shipbuilding yard at Nicolaieff, Russia. The new works are not only to be lighted throughout by electricity, but it has also been decided that all the machinery shall be operated electrically. The contract for the supply of the whole required for the new works, both engineering and electrical, has just been placed with the Société Cockerill, of Seraing, Belgium.

The Horseless Carriage.—In a paper read at Edinburgh on "Horseless Cars and Carriages," on 17th inst., Mr. Geo. Johnston put forward a new name for horseless carriages. With autocar, motorcar, horseless carriage, and a host of other names, we thought there were sufficient; but just as "autocar" is becoming the more general expression, Mr. Johnston suggests "mocar," and says he will call it this in future. Mr. Johnston may do as he wills, but we prefer "autocar." Perhaps naming this is one of the important duties lying before the eminent members of the Honorary Council of the Crystal Palace Carriage Exhibition.

The Electro-Harmonic Society.—Next Friday evening will see the close of the Society's Concerts for the 1895-96 season. A very varied and excellent programme has been arranged, and members and friends will doubtless muster in strong force, for while purely classical music has not been neglected, the majority of the selections are of a light and popular nature. The programme will be found in our Supplement, as usual.

This Year's Exhibition.—A Belvedere tower, nearly 200 feet in height, similar to those erected at the World's Fair, Chicago, and the Paris and Philadelphia Exhibitions, will be erected this season at the Empire of India and Ceylon Exhibition. The tower will be illuminated at night by a lighthouse lamp of 4,000,000 candle power.

An Electricity Meter Competition.—Among the many gold medals being offered for competition this year by the Société Industrielle de Rouen is one for an improved electricity meter, capable of accurately registering the quantity of current passed from very low up to very high quantities. The competition closes on September 30th next, all models, &c., to be sent to the Société Industrielle de Rouen, 2, Rue Ampère, Rouen, France, from whom full particulars may be obtained.

Personal.—The Guild of Church Musicians, London, has conferred the degree of Fellowship (Honoris Causa) upon Mr. Robert Hope-Jones, M.I.E.E., formerly of Birkenhead, in recognition of the services he has rendered to the cause of church music by his recent inventions in connection with the organ.

Crystal Palace Carriage Exhibition.—On Friday the 6th inst., at the Mansion House, a meeting was held of the Honorary Council, presided over by the Lord Mayor, to consider certain matters connected with the forthcoming International Horse and Horseless Carriage and Roads Locomotion Exhibition to be held at the Crystal Palace. The Lord Mayor (Sir Walter Wilkin) opened the proceedings by expressing his pleasure in welcoming those present to discuss the arrangements of an exhibition which was likely to be interesting and profitable to the particular branch of trade. The Secretary of the Crystal Palace Company (Mr. Wm. Gardiner) addressed the meeting regarding the facilities offered at the Crystal Palace for such an exhibition. Sir David Salomons followed with a somewhat lengthy review of the history of the horseless carriage agitation, and general considerations of the question, along with references to the Bill now before Government. He concluded by moving a resolution to the effect that the present time is opportune for such an exhibition, that the Crystal Palace is the most suitable *locale*, that the exhibition would have a highly advantageous effect upon the industries involved, and would also stimulate the engineers of this country to greater efforts in improving and perfecting the motors and mechanical arrangements of self-propelling vehicles. This very comprehensive resolution was seconded by Mr. Geo. J. Jacobs and carried unanimously. A number of other resolutions were also submitted, electing executive and other committees, and appointing Mr. A. R. Sennett the honorary executive commissioner. Other speeches were delivered by Major Flood Page, Prof. Hughes, Mr. Sennett, Mr. George Hooper, &c. The prospectus which has been issued gives a classification of exhibits. The Exhibition will be divided into twelve sections, Nos. 10, 11 and 12 dealing with material, plant, and machinery for the carriage building and auto-motor vehicle industries, mechanical road locomotion, and horseless carriages, the last including every kind of self-propelled passenger vehicles. Class R is for "mechanically self-propelling passenger carriages (public or private) of all kinds driven by electricity." There are several electrical items in other classes.

Bi-metallic Wire.—*Electrical Age* (New York) says that it is the intention of the Bi-Metallic Electric Transmission Company to place bi-metallic wire upon the market—the wire being composed of copper and steel, steel core with copper sheathing, combining great tensile strength with conductivity and, at the same time, securing to the user the "bi-metallic" effect. The wire sold by this company is manufactured for it by the John A. Roebling's Sons Company, and is claimed to be perfect mechanically as well as electrically. We would point out to our contemporary, and to the company also, that this is a very old type of wire that they state is now being "introduced." Of what was the first New York-Chicago experimental telephone line composed?

Expert Honours.—Truly the lot of the expert is a hard one. To be mistaken for the poet of his name was once the misfortune of Mr. James Swinburne; but that the eminent expert has survived. A gas contemporary, in recording his evidence in the great incandescent gas litigation recently occupying the attention of the London Courts, made our friend appear under a new *rôle*. "*Professor* James Swinburne in the Box," is a sub-heading, and Mr. Swinburne is honoured in similar terms right through our contemporary's summary of his evidence.

Electrical Engineers Wanted.—In our advertisement pages will be found particulars of a vacant position for an assistant electrical engineer in connection with the Hampstead Vestry electric lighting undertaking.

The Ashton-under-Lyne Corporation invites applications for the appointment of consulting electrical engineer to advise as to a contemplated scheme for the supply of electric lighting within the borough.

The Bolton Corporation wants an electrical engineer at £300 per annum, to take the place of Mr. Rider, who goes to Plymouth.

Marriage.—Yesterday's *Daily Telegraph* announces that on January 22nd, at St. Anne's Church, Homebush, Sydney, Australia, Mr. John Francis Albright was married to Nellie, daughter of the late G. W. Johnson, of London.

Belt Strain.—To find out whether the force carried by a belt is more than should be properly put upon it, or upon its fastening, we must know, says the *Scientific American*, how much the arc of contact is, and what the tension on both the tight and the slack folds. The greatest tension upon it is that in the tight fold or side; and this is equal to that on the slack side, plus the pull which the belt gives to the pulley, or which the pulley gives to it. The greater the arc of contact, the greater the ratio between the tight and the slack side, and the less the strain will be upon the belt and its fastening, to transmit a given power at a steady speed. Thus, if we have a pull of 10,000 lbs. necessary to carry a certain horse-power, when the arc of contact of the belt on the pulley is 90°, that means that the ratio between the tension on the tight side and that on the slack side is 1·874; in other words, for every pound upon the slack side there will be 1·874 lbs. on the tight side; and if the difference between the tensions on the slack and the tight sides be 1,000 lbs., it will be necessary to have 1,000 ÷ 0·874 = 1,144 lbs. strain on the slack fold, and 2,144 on the tight one. (These figures apply to leather belts in good condition upon cast-iron pulleys, also in good condition.) Working from this we get the following table for various arcs of contact from 30° to 300°:—

Table of Greatest Strain on Belts.

Arc. Degrees.	Ratio between strain and transmitted pull.
30	5·29
45	3·71
60	2·92
75	2·45
90	2·14
105	1·93
120	1·77
135	1·64
150	1·54
165	1·47
180	1·40
195	1·35
210	1·30
240	1·23
270	1·18
300	1·14

Now, suppose that it takes a pull of 300 lbs. to carry a given horse-power when the arc of contact is 195°, we find that the strain upon the tight side will be 1·35 × 300 lbs., or 405 lbs. Getting it down to horse-power instead of pounds pull, suppose that it is necessary to carry 175 horse-power with a belt running 2,000 feet per minute, and having 210° arc of contact; then the pull on the pulley will be 33,000 × 175 ÷ 2,000 = 2,887 lbs.; and the greatest strain upon the belt will be 2,887 × 1·3 = 3,753 lbs.

Some New Forms of Cells.—In the *Philosophical Magazine* and in the *Comptes Rendus*, two new forms of cells are described, which are worthy of notice. The first of these is a tin chromic chloride cell, by Sidney Skinner, and consists essentially as follows:—A cell is formed, in which one electrode is a tin amalgam at the bottom of a test tube; the other a platinum plate, and the electrolyte is a solution of green chromic chloride. The action of this compound on tin is a reversible one, $Cr_2Cl_6 + Sn + SnCl_2 + 2CrCl_2$, the direct action occurring at high temperature. The author shows that the E.M.F. is not zero at ordinary temperature, as stated by Case; but it is about 0·44 to 0·52 volt, and alters only very slightly when heated to 100°. The cell polarises, however, so rapidly at low temperatures, that at the moment of connection, the effective E.M.F. is almost zero, which is the probable cause of Case's results. For further details consult *Philosophical Magazine* (5) 39, 444—447. The other form of battery has been described by Morisot, and seems to possess some interesting features. The outer cell contains a plate of gas carbon immersed in a mixture of one volume of sulphuric acid with three volumes of a cold saturated solution of potassium dichromate; the inner cell contains an amalgamated zinc plate in a concentrated, aqueous solution of sodium hydroxide, and there is an intermediate porous cell containing a solution of sodium hydroxide of sp. gr., about 1·05. The object of this intermediate cell is to retard the formation of normal chromate in the outer cell, and of zinc hydroxide round the zinc plate. The E.M.F. of the cell is 2·5 volts at first, provided the porous cells have become thoroughly impregnated with liquid before the circuit is closed, and remains higher than 2·4 volts, even after 10 hours uninterrupted action. The substitution of a concentrated solution of sodium hydroxide for the dilute acid in a Bunsen cell, has the same effect on the E.M.F., and increases it by 0·4 volt. The zinc is less readily attacked by the alkali solution than by the ordinary dilute acid, but the expenditure of zinc is partly replaced by expenditure of alkali, and if carbon is substituted for zinc in the inner cell, there is at first an E.M.F. of 1 volt. If the zinc were attacked to the same extent as in the Poggendorff cell, there should be an E.M.F. of 3·1 volts. After some time the zinc acquires a grey coating, which is rapidly removed by immersing it in dilute acid. The dilute alkali solution in the intermediate cell should be renewed from time to time. No advantage is gained by using potassium hydroxide in place of sodium hydroxide, or sodium dichromate in place of the potassium salt.

The Influence of Pressure on Electrical Conductivity.—We have often had occasion to notice the valuable contributions which, during the past year or two, Gustav Famman has made to our knowledge of the electrical conductivity of solutions. During the past few months another phase of the subject has been engaging his attention, namely, the influence of pressure on the conductivity of solutions. His paper, which may be consulted in the *Zeitschrift für Physikalische Chemie*, xvii., pp. 725—736, is, as usual, remarkable for the clearness of its expression and the suggestive conclusions which are stated. He divides the influence of pressure upon conductivity into three factors, namely—(*a*) volume alteration, (*b*) alteration of viscosity and ion friction, and (*c*) alteration of the degree of dissociation. Those who are familiar with this subject may remember that the effect of pressure on viscosity was determined three years ago by Cohen (*vide Annalen der Physik und Chemie*, 1892 [2], xl., p. 661). For common salt solutions, the viscosity of solutions of small internal pressure diminishes with increase of pressure, the reverse obtaining with solutions of high internal pressure. The effect on the dissociation constant is given in a table of percentage alteration due to pressure of 500 atmospheres for solutions of varying concentration and dissociation. Having set these values forth, Famman proceeds to consider the total effect, and to illustrate his remarks with typical curves. At infinite dilution, factors (*a*) and (*b*), as given above, are alone of any special influence, and these cause an increase of about 4·5 per cent. If the concentration increases, three types of curves are obtained, namely—(1), where the electrolyte is fully dissociated, the curve rises to a maximum and slowly falls; (2), where the dissociation is great, and factor (*b*) of small account, the curve is at first almost parallel to the axis of concentration, then slowly sinks, owing to the effects of viscosity, and finally cuts the axis; (3), for immediate dissociation, the rise is not as rapid as in (1), and a well-marked maximum occurs. The curve is also given for sulphuric acid, and its appearance and significance briefly discussed. From the conclusions drawn, it is obvious that we are a long way from realising finality in our knowledge of this branch of our subject.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

House-to-House Electric Light Supply Company, Limited (25,913).—This company's annual return was filed on March 6th. The capital is £350,000, in £5 shares (57,900 ordinary, 100 founders', and 12,000 preference); 8,322 ordinary, 100 founders', and 5,000 preference have been taken up, and 1,000 ordinary and 100 founders have been issued as fully-paid. The full amount has been called on the rest, and £61,610 has been paid.

British Electric Traction (Pioneer) Company, Limited (45,897).—This company's statutory return was filed on March 4th. 5,000 shares have been taken up out of a capital of £100,000 in £10 shares; £2 per share has been called, and £10,000 has been paid.

Cuba Submarine Telegraph Company, Limited (4,710 C).—This company's annual return was filed on March 3rd. The whole nominal capital of £220,000, in £10 shares, has been taken up, and the full amount called and paid.

Cambridge Electric Supply Company, Limited (36,457).—This company's annual return was filed on February 13th; 4,077 shares have been taken up out of a capital of £50,000 in £10 shares; £8 per share has been called, and £32,616 has been paid.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation March 11th.	Closing Quotation, March 18th.	Business done during week ended March 18th, 1896. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	102	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	10½— 11	10½— 11	10⅝	10 11/16
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	46 — 48	46 — 48	47	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	87½ — 88½	87½— 88½	88⅛	87⅛
2,993,560£	Do. do. Defd.	Stock	...	...	...	7 — 7⅛	7⅛— 7⅜	7 13/16	7⅜
130,000	Brazilian Submarine Teleg., Ltd.	10	6¼% §	7 %	...	14½— 14¾	14½— 14⅝	14⅝	14⅜
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	111 —115	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3 — 3⅛	3 — 3⅛	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telap. Const. and Main., Ltd.	10/-	2 % §	1½%	...	1/16— 3/16	1/16— 3/16	1/16	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13⅛	12½ — 13½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½— 21½	20½— 21½	20⅝	20⅜
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	105 —108 %	106 —109 %	...	...
60,710	Direct United States Cable, Ltd.	20	2⅝% §	2 %	...	9½— 9¾	9½— 9¾	9½	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6¼% §	6½%	...	17 — 17½	17 — 17½	17½	17
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18 — 18½	18 — 18½	18 5/16	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	105 —108	105 —108	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	129 —132	129 —132	131¾	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	17⅞ — 18¼	17⅞ — 18¼	18¼	18
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	...	101 —105	101 —105	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	...	102 —105	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	128 —131	128 —131	128	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	101 —105	101 —105	...	...
107,600£	Do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	105 —108	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	...	112 —115%	112 —115 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅜% §	4½%	...	10¼— 10⅝	10¼— 10⅝	10⅞	10½
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	...	16¾— 17½	16¾— 17½	17⅛	16⅞
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	...	22¼— 22¾	22½— 23	22⅞	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	102 —105	103 —105	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	47 — 50	47 — 50	48½	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	...	105 —108	106 —109	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5⅛%	6⅜— 7	6⅜ — 7	6 15/16	6¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17¼	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16½— 17½	16½— 17½	17¼	17
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅜ — 6¾	6⅜ — 6¾	6⅝	...
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 —107	105 —108	106⅜	106
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	...	9/16— 11/16	9/16— 11/16	9/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	108 — 111	108 —111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	...	5 — 6	5 — 6	...	...
3,381	Submarine Cables Trust	Cert	...	...	...	132 —137	132 —137	...	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	3½ - 4	3½— 4	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	95 - 100	97 —102	98⅜	98
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	...	5½ - 6½	5½— 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	101 —104	101 —104	...	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	94 — 99	94 — 99	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	...	8⅝— 9½	8½— 9	8 15/16	8½
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6½ — 7	6½ — 6⅞	6 13/16	6½
33,129	Do. do. do. Def. Ord.	⅞	...	1 %	...	2½ — 3	2½ — 2⅝	2 15/16	2½
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	...	102 —106	102 —106	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	102 —106	102 —106	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	¼%	...	1 — 1⅛	1 — 1⅛	1	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10¾ - 11¼	10⅞— 11¼	11 1/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9 — 10	9 — 10	9¼	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	108 —111	108 —111	108	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	113 —118	113 —118	...	...
164,300£	Do do 6 % Ster. Bonds.	100	6 %	6 %	...	102 —105	102 —106 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4⅛%	4⅛%	5 %	6⅞— 7⅛	7 — 7⅛	7 1/16	7⅛
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7 — 7½	7¼— 7⅜xd	7⅜	7¼
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	115 —118	116 — 119	117	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14 — 15	14 — 15	14⅜	14¼
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	16 — 17	16⅞	16½
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	134 —138	134 —138	136	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8 — 9	8 — 9	...	...
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	...	10 — 11	10 — 11	...	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5⅛%	...	7⅞— 8	7⅞— 7¾xd	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	...	12⅝ - 13½	13 — 13½	13⅜	13
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	116 —119	118 —120	119½	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	8¾ — 9½	8¾ — 9½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	9¾ - 10½	9¾— 10½	9 15/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9¼ - 9⅝	9¼ — 9⅝	9⅝	9½
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	9¼— 10	9½ - 10	9¾	9⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Mar. 11th.	Closing Quotation, March 18th.	Business done during week ended Mar. 18th, 1896. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	5 % §	2½%	...	1⅛ — 1⅜	1⅛ — 1⅜	1⅛	1¼
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1⅝ — 1⅞	1⅝ — 1⅞	1 11/16	...
125,000£	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	4½%	...	110 —115	110 —113	...	...
630,000£	City and South London Railway	Stock	1 1/16%	1 1/16%	1 1/16%	40 — 42	40 — 42	40½	40¼
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	...	2¼ — 2⅜	2¼ — 2⅜	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	...	1½ — 1⅝	1½ — 1⅝	1⅝	...
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	...	3 — 4	3 — 4 xd	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	103 —106	103 —106 xd	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	1⅛ — 1⅜	1⅛ — 1⅜	1¼	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2¼ — 2⅜	2¼ — 2⅜	2 1/16	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅜ — ⅞	⅜ — ⅞	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅝ — ¾	⅝ — ¾	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil*	...	¼ — ⅜	¼ — ⅜	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	...	9½ — 10½	9½ — 10½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	15½ — 16½	16 — 17	16½	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	16½ — 17½	17 — 18	17⅞	17¼
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	107 —112	107 —112	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	19 — 20	19½ — 20½	20	19½
200,000£	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	103 —105	103 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅞%	13⅜ — 14	13⅞ — 14½	14	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅜ — 16	16⅜ — 16⅞	..	
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	39 — 42	38 — 41 xd	40⅛	38
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	6 — 6¼	6 — 6¼	6⅜	6¼

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 189
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6¼.
Electric Construction Corporation, 6 % Debentures, 103—106.
House-to-House Company (£5 paid), 3¼—3⅜.
Do. do. 7 % Preference, of £5, 7⅞—8¼.
Do. do. 4½% Debentures of £100, 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 8—8½; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.
Liverpool Electric Supply, £5 (fully paid), 7⅜—8¼
London Electric Supply Corporation, £5 Ordinary, ⅜—½.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6⅞—7¼.

Bank rate of discount 2 per cent. (February 22nd, 1894).

THE RÖNTGEN X RAYS.

A CONSIDERABLE amount of research on the X rays has lately been carried out chiefly in Continental laboratories. These investigations have added greatly to our knowledge of the properties of the X radiation and its method of production, though we appear to be as far as ever from any certain knowledge of its real nature. The rapid progress that is being made in this new science is, no doubt, due to the fact that as yet there is no monopoly in a scientific discovery, Prof. Ramsay's proposal to establish such a monopoly having fortunately not met with much support.

As we have already mentioned, Poincaré has suggested that probably all phosphorescent bodies emit the X rays. This view appears to be confirmed by the experiments of various investigators. M. Niewenglowski,* in his experiments, wrapped a sheet of sensitive photographic paper in several folds of black or red paper, placed above the envelope two pieces of money, and covered one half with a plate of glass coated with a phosphorescent powder (sulphide of calcium). After four or five hours of exposure to the sun, the part of the sensitive paper under the half of the envelope submitted directly to the solar radiation, remained intact, and showed no trace of the piece of money placed above it; the part, which received the solar radiation only after its passage through the phosphorescent plate, had completely blackened, except in the place covered by the piece of money. M. Becquerel's† experiments were made with the double sulphate of uranium and potassium. A gelatino-bromide plate was enveloped in two sheets of thick black paper, so that an exposure to sunlight for a day produced no effect upon it. A plate of the phosphorescent substance was placed upon the envelope, and exposed to the sun for several hours, on subsequent development, a silhouette of the phosphorescent plate appeared in black on the plate. If a piece of money is interposed between the phosphorescent plate and the envelope, an image of it is obtained on the negative. The same effects are obtained when a thin sheet of glass is interposed between the phosphorescent plate and the envelope, which shows that the effects are not due to the chemical action of vapours which might be given off when the phosphorescent substance is heated by the sunlight. Phosphorescent substances, therefore, appear to emit rays, which resemble the X rays in passing through opaque bodies and acting on sensitive photographic films.

MM. Auguste and Louis Lumière* have shown that the relative sensitiveness of photographic plates is the same for the X rays as for ordinary light. Plates whose sensitiveness to light varied in the ratio of 1·8 to 30 were used in these experiments, and this ratio was found to be exactly maintained when they were exposed to the X radiation. Other experiments were made to test the absorption of the X rays by the sensitive layers. A packet of 250 sheets of gelatino bromide paper was exposed under a perforated screen of copper to the X radiation. After a ten minute exposure, the impression of the screen was found to have penetrated to the 150th sheet. M. Zenger has found that eosine orthochromatic plates, and plates soaked in sulphate of quinine are considerably more sensitive to the X rays than the ordinary plates.

An interesting series of experiments has been made by MM. Darien and de Rochas,† which may help to show the reason why the eye is not sensitive to the X rays. The eye was found to be very opaque to the X rays. An eye from which the membranes at the back had been removed, so that objects could be seen through it, was placed on the envelope of a photographic plate, alongside a couple of fingers and a

* *Comptes Rendus*, t. 121, p. 383.
† *Comptes Rendus*, t. 122, p. 420.

* *Comptes Rendus*, t. 122, p. 382.
† *Comptes Rendus*, t. 122, p. 458.

piece of wood, and the whole was then exposed for half an hour, about 8 cm. below the Crookes tube. The negative showed that the eye, which had been more directly exposed to the X rays than the fingers, appeared to be more opaque than the muscles, but less opaque than the bone. The axial part of the eye, through which we see, was the most opaque to the X rays.

It will be important for dealers in diamonds to know that the X rays furnish an infallible test for separating real stones from imitations. The real diamond is much more transparent to the X rays than the artificial diamond, according to the experiments of MM. Buguet and Gascard.* The difference can be shown by the photographic plate when a permanent record is required, or it may be detected more rapidly by the phosphorescent screen. Real and imitation jet can be distinguished in the same way.

MM. Benoist and Hurmuzescu† have used the electroscope to establish some important properties of the new radiation. As J. J. Thomson and others have shown, an electrified disc of an electroscope, even when surrounded by a Faraday cylinder, is readily discharged by the X rays. Taking advantage of this simple and delicate test, these scientists have shown that the law of inverse squares holds very approximately for the X radiation. Also they have succeeded in explaining the cause of the great difference in the coefficients of transmission obtained by different experiments. It will be remembered that this formed one of the chief differences between the Lenard and the Röntgen rays. MM. Benoist and Hurmuzescu have found that the coefficient of transmission depends on the thickness, in the case at least of aluminium, with which their experiments were made. In plates of aluminium from 0·1 mm. to 0 6 mm. thick, the mean coefficient was found to be 0·85; in plates from 0·6 mm. to 1·1 mm., it was found to be 0·899. Another result of these investigations was that the coefficient of transmission varies with the working conditions of the apparatus exciting the tube. This same observation was, however, made by Lenard in his investigations.

Elihu Thomson has produced stereoscopic pictures by means of the X rays. As may be readily imagined, this can be done by displacing the Crookes tube or the object to be photographed, so as to cause the rays to fall on the object to the right and to the left of the normal to the surface of the plate. The two pictures thus produced are looked at in the usual way by an ordinary stereoscope. He also suggests a method of getting a stereoscopic effect in the so-called cryptoscope, by the well known method of projecting on the screen the right and left hand pictures in rapid succession. A revolving shutter in front of the eyes is driven synchronously with the interruptions of the two sources of light, so that each eye sees only one of the two pictures. Stereoscopic pictures would undoubtedly be useful in surgical applications to fix the exact position of objects in the line of sight.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

Discussion on the papers "On Electrical Wiring," by Mr. Sam Mavor and Mr. F. Bathurst.

(*Concluded from page* 358.)

Mr. Crompton said the remarks he wished to offer lost a great deal of point through being given at the wrong end of the discussion. He had intended, in December, to open the discussion by pointing out to the members that a committee had been sitting for some months to revise their wiring rules, and that that committee looked with great interest to the discussion to follow these papers, as the question of casing and of various systems of conduit and concentric wire had been under consideration, and they hoped to hear the experience of members in regard to the use of these various methods. To a certain extent they had been disappointed in this, and he regretted very much that so few remarks had been made by those who had used these systems, and who, they had hoped, would have given them their experience. It appeared to him that they were on the eve of a very great revolution in the art of house wiring. The new Board of Trade regulations, in allowing the use of a greater pressure, were also stipulating that one side of the system should be earthed, and, therefore, they had to contemplate a new condition of affairs, and they had really now to consider whether they could not at once direct their ideas to the most perfect system of wiring, which he thought had been already mentioned by one speaker, by putting one highly insulated wire concentrically within a pipe, which, at the same time, formed the casing, and also formed the return wire. That did appear a very perfect system. No doubt it had many disadvantages for those accustomed to the present systems, but he believed that when thoroughly thought out they would really get to that in the end. They had to thank Mr. Mavor and Mr. Andrews for being practically the first to lead them in that direction. He believed he was one of the first speakers who had done justice to those gentlemen. His firm had used a considerable amount of concentric wiring, and it had been very successful. He was quite surprised to hear so little said in praise of the system by other speakers. No doubt it had been more used in factories and places of that kind than in private houses, but it had been used in very difficult situations, in places where it would have been difficult to obtain high insulation by the ordinary methods, and it had obtained that insulation by what he might call the air-tightness of the system, every single part being closed, and the insulation resistance kept up by preventing the entrance of damp to all those very weak points to which previous speakers had called attention, the points at which the fittings were attached. This concentric wiring system was the only one which thoroughly drew attention to the importance of protecting and making continuous the casing up to those points where the air could be excluded from the insulation. It appeared to him so easy to do with the concentric system, and so difficult with the double wiring system, that it pointed very much in favour of the concentric system. There was another point which had not been sufficiently dealt with, and that was the lamp fittings. Mr. Mavor had said how much superior the concentric lamps were to the ordinary kind. He thought they would find the double lamp fitting which they had been using for some time past a great nuisance and very expensive, and householders would find that they made their insulations very costly to maintain. The reason was obvious: they had to get a number of small parts, and it was difficult to make comely fittings with so many small parts. This was greatly avoided by the concentric lamp fittings, and was a point strongly in their favour. He thought they might find other strong points in the extra simplicity of only having one insulated wire. He wished very strongly to say, speaking as one of the committee on wiring rules, that one of the real good things they had got out of this discussion was the strong condemnation of casing, and it was evident that the days of casing were numbered. Casing had been a very good servant when nothing else was available, but the time had come when they must go in for something more substantial, and less liable to cause a trap in the shape of electrolytic bridges between the wires. There could be no doubt that it had caused these traps, and that fires had resulted, although probably Mr. Heaphy would not admit it.

Mr. Fred. Bathurst,* in his reply, said: Owing to the discussion having been more upon the general considerations governing the question of wiring than upon the particular points advanced in the papers read, he would ask to be excused from taking the criticisms *seriatim*, and be allowed to reply to the various points raised, as they fell in place from a reconsideration of his paper. Those who had taken part in the discussion seemed to have taken their points, or, if he might speak in metaphor, their fangs severely alone, perhaps under the impression that Mr. Mavor and himself would ultimately settle their particular differences and become as of one mind, in accordance with the fashion recently set for them by the two boa constrictors in the Zoological Gardens. The incident he referred to was probably still within the remembrance of those present. An analysis of the criticism would show that the economical rather than the technical side of the question had been taken throughout. Starting with his five cardinal points for good wiring—safety, durability, convenience, accessibility, and economy—although convenience had, in some small measure, been touched upon, the last two points were the only ones that really stood questioned. Taking accessibility first, perhaps the main criticisms were at once removed when he stated that he used this word mainly in the sense of reliability. Conductors were not to be pulled in and out, except in the case of mishap (and no one surely could gainsay the fact that electric wiring of all kinds was exposed to trouble), and he maintained that it was a factor of great reliance, and even of paramount importance, to feel that it was possible to remove or replace electric conductors without any disturbance of their surroundings. It was Mr. Corlett, he thought, who said he thought there was a great deal of unnecessary prejudice shown about burying wood-casing enclosed wires directly in plaster, and argued that they had never yet heard of householders complaining of the "inaccessibility" of their gas pipes. Perhaps not, but he thought his point failed in application. A gas pipe, under ordinary circumstances, would not allow more than a certain quantity of gas to pass through it, and no matter how many burners were put on to it, or other orifices which were made, the flow of gas could never damage the pipe. To compare an insulated wire with a gas pipe, the thin insulating coat represented the pipe itself, whilst the copper conductor represented the orifice. That kind of orifice would carry as much current as they would give it, and with immediate injury to the insulating sheath or pipe. In fact, it was a simple matter to destroy both. If gas pipes had an unfortunate facility for leaking or bursting upon the slightest provocation, say upon the appearance of moisture or an unanticipated extra consumption, would they not have complaints? Would not every gas pipe have to be accessible? The conditions governing gas piping and electric wiring were in that particular diametrically opposed. Several speakers had intimated the necessity of controlling the work of irresponsible workmen or contractors; had any suggested a "check" more legitimate or satisfactory than "accessibility"? From the other point of view, the growth of electrical application was so rapid, and so far almost untouched, that if they were to recognise the demand of the supply stations for

* *Comptes Rendus*, t. 122, p. 457.
† *Comptes Rendus*, t. 122, p. 379.

* Corrected by the speaker.

day load, and had any regard for the convenience as well as the pockets of their customers, they ought to give them accessible wiring, so that any possible and legitimate requirements could be met, and later alterations effected with a minimum of trouble, inconvenience, and expense. He submitted his point that every electric conductor in house wiring should advisably be accessible. Turning to economy, this was really the crux of the whole question. It appeared at least to be tacitly admitted that wood-casing was technically wrong and undesirable, although its cheapness and ready convenience was, in some quarters, considered to outweigh its immediate or prospective disadvantages. As he had tried to point out the technical defects incident to its use and employment, those conservatives who still pinned their faith to it had questioned conduit methods on the score of economy. He would try and rebut their statements. Those critics all admitted the mischievous and harmful commercial conditions which now obtained in the electric wiring industry, and in face of the complaints rife from every section of it, they could indeed hardly do otherwise. He believed they had reached the turning point when inquiry into their present methods must and would be made; for, in spite of an enlarging commercial field, it could almost be said that no one was deriving any benefit. The wireman complained that he could not make a "living wage," and was being ousted by inferior workmen. Wood casing manufacturers said that they made casing without profit, and simply in order to keep their moulding machines full of work. The porcelain manufacturers were combining in an endeavour to keep up even present prices, whilst the sum total effect was being most seriously felt by the electrical supply houses, who were asked to make cheaper fittings, and extend longer credit. Those conditions must be faced and a solution found. He contended that the principle they had heretofore been working upon was incorrect. They had been using wood casing and metal pipes, and by so doing had not only introduced unnecessary difficulties and troubles, but had crippled themselves commercially. For want of any suitable protecting medium, they had had to adhere to highly insulated, costly and expensive wire (rightly, perhaps, so far); but as a principle, they had insisted upon having electric conductors insulated, so that they could practically look after themselves, without receiving anything beyond a slight mechanical protection from the supporting or surrounding medium. They had now nearly exhausted that demand for wiring, which came from those who were willing to pay any price they were asked, and were beginning to feel the pinch and necessity for "lower cost" wiring. He held that wood casing or ordinary metallic piping was impotent to meet those conditions. Let them take the cost per point to a contractor for wiring a certain building, as, say, 10s. per point (that was for the wiring only, without fittings), the analysis of this cost would probably be approximately—1s. 6d. for wood casing and accessories, 4s. 6d. for wire and jointing material, 4s. for labour of erection. Casing was the lowest item, whilst labour and wire came out about equal. His contention was that it was advantageous to the contractor to employ methods which would reduce the labour item, and perhaps also the wire item, even if the other one remaining—casing or other supporting material—was thereby increased. If using the plain insulating conduit before them, the work would cost, say, 3s. for insulating tubing and accessories, 3s. for wire, and from 2s. to 3s. for labour of erection. The special twin wire to be used was listed at prices 25 per cent. lower than the ordinary 400 megohm quality, and contractors could testify to the satisfaction it gave, and the labour saving possibility of conduit methods. He was speaking from what had already been done, and stood by the statement that contractors could buy plain tubing and special twin conductor wire together at the same cost as ordinary wire, so that the cost of wood casing was entirely saved. Technically considered, wiring of that nature must, on fair examination, admittedly be at all points superior to that employing wood casing; practically, it had distinctly proved itself so in other countries, and it was making its reputation in England. He would, at that point, and for the moment, admit the criticism which could be made that that tube was not nail proof, and that specially insulated wire was employed. The principle followed, however, was that of insulating conductors sufficiently to look after the voltage upon them, and providing for their protection a better and more complete surrounding material. Mr. Rawlings had suggested that the conduit should be flexible. He (Mr. Bathurst) could not agree with him on that point, as his experience dictated that, for ordinary wiring, at least, a rigid conduit was preferable. There might be cases where "flexibility" would save labour and cutting away, but usually also "accessibility" was then lost. He could not conceive a flexible conduit, nail and waterproof, and insulating. The flexible hose used in steam fitting work was perhaps the nearest approach. This, with a pressure inside, was waterproof, but not nail-proof. This one requirement seemed to involve the use of material "as hard as iron," which, in itself, was incompatible with any great degree of flexibility. Several speakers had advocated that iron piping was preferable to wood casing, from the fact that it afforded better mechanical protection. He was glad to hear one engineer at least—Mr. Campbell Swinton—say his experience made him believe that iron piping led to as much, and even more, trouble, electrically, than wood casing. Many well-known contractors had personally told him (the speaker) of the troubles they had already experienced with iron pipe—some of those faults were caused electrolytically; others of the damage done to the rubber insulating material on the conductors by excess of oil used when screwing up the couplings of pipe lengths; others of mechanical injury to wires whilst being drawn in, but, strange to say, they had in that room, before their brother contractors, preferred to remain silent. Surely it was better to face the question there and find solution, rather than wait until the public themselves decided whether or no there was any cause to find fault with it, or that it created a danger aspect? He must again, perhaps, be content to wait until time should prove his contentions technically. Economically, however, they had no ground to stand upon; they could not, if following their present lines, give a system of iron piping with two, or even one, insulated copper wire inside it, and compete in price with ordinary gas piping. Although it might appear paradoxical, that *could* be achieved with an insulating tube system, and even if that tube had to be iron-armoured throughout its length. Whilst one or two speakers had doubted the necessity of placing an interior insulation on the inside of an iron pipe, and for the moment disregarding the obvious reasons which must sanction such practice, none of them (he had, perhaps, to except Mr. Dykes, who was about to touch on this point when the "time-closure" silenced him) had attempted to refute its advisability on technical grounds, so they could take it that if it was doing no actual good there, it was at least doing no harm. The main fault in their eyes was, that it added extra cost. It would be allowed that a lining prevented mechanical damage to the wire, and increased the facility with which wires could be drawn in. It prevented internal condensation, and so obviated the presence of moisture and consequent rust. It must, therefore, tend to preserve the conductors under more favourable conditions. The insulating coating being under the iron pipe was not liable to any chance mechanical injury, and therefore some sort and thickness of insulation could always be depended upon. In other words, insulation *was* added to the conductors. Did not this fact of being able to preserve some insulating material intact under all circumstances tell against those who advocated a very high insulation an the wire itself? He said that in spite of Prof. Ayrton's predilection. Those same advocates would not gainsay the statement that the wireman's boot could in a moment make away with any number of megohms asserted for the quality of the wire whilst it was being put up. His statement as to the actual insulation that particular lining gave to conductors within it, and the voltage it could stand without breaking down, as well as its shielding and subduing effect in the case of a short circuit, he could only accentuate by asking those interested to verify by test. Two million lamps were making that test in other countries. So much for technical reasons for advocating insulated iron pipes. If economy was sought, the co-operation of the wire manufacturer must be invited. Without arguing the fact that the present quality wire had primarily been designed to look after itself, and that instances had been given by which its possibilities in that respect could be proved, and admitting that the present type of insulated wire was as near the margin of efficiency as it should be, consistently for present methods, it could be urged that other types could and should be found. Had those who cried out against permitting lower insulation wires ever considered their own practice? Had those critics ever protested against the use of the ordinary flexible cord? The insulation test on that (excepting the vulcanised variety) could not be taken in water, and probably gave 300 megohms in open air conditions. The insulating medium was a thin strip of pure rubber secured by a cotton covering. Oftentimes the rubber was a covering only in name. Yet experience surely sanctioned its use and admitted its convenience and economy. Did those critics remonstrate because they found commercial exigencies made it convenient to put further trial on that thin insulation by hanging a three or four pound weight at the end of each cord in the shape of lamp-holder and shade? What did they say to its further aggravation by passing it over a number of friction pullies in adjustable fittings? The present stress of competition was noticeably increasing the amount of flexible cord being used, and his critics must notice that single lamps were rapidly changing into three or four-light clusters. The development of that practice might not prove that it was right, or even desirable, but he maintained that it *did* point to the possibility of getting away from the megohm variety of wire. What harm, he asked, could result, even if wires of no better insulation were installed in an armoured insulating tube which could look after them mechanically and electrically, and in which any short circuit it was possible to make under practical conditions was rendered innocuous? Insulated wires, less costly but equally as serviceable and effective when in protecting tubes, could, he asserted, be produced. Let them have a good and serviceable insulation by all means, but the question which should be settled perhaps with wire manufacturers, insurance men, and wiring contractors in joint conference, was, where was the mean which met the requirement of efficiency with the commercial demand for economy? Safety, he was already convinced, was the least question, because it could be provided for by using an insulated tube. Once this question of wire was settled, they saw the gain of further advantages from conduit methods. A small twin conductor was employed which required a tube of smaller orifice for the conveyance of electricity than was required for the conveyance of gas, taking light for light capacity. An armoured insulating tube created the possibility of a large labour saving factor, for sliding couplings and cemented joints could be used, and would make a watertight electric system. Screwed couplings were rendered necessary in gas piping so as to successfully resist the internal pressure. Working on centre of distribution methods, they would find that only ⅜ths inch and ⅝ths inch tubes need be used, for all twin conductors up to 5 or 6 amperes capacity would go into the former, and up to 10—12 amperes capacity in the latter. Sub-mains could feed from main fuse and distributing boards in ⅝ths inch, or perhaps 1 inch tubes. The bugbear of wood-casing—the difficulty of estimating labour—would be removed, because the conduit wiremen would put up tubes by contract per foot run, as was now being done with gas piping. Tenders for work would then become comparable with one another. Mr. Geipel had rightly accentuated the importance of the outlet points, and all would, he thought, admit the advantage of using a small insulating box, armoured where necessary, which was equally applicable either for jointing, although taped joints would be unnecessary, or for the insertion of branch connecting blocks, switches, wall plugs, and even ceiling roses. Mr. Wallis-Jones had rather taken the words out of his mouth when he said they had passed through a wood age, a stone or earthenware age, and were now in the insulated iron age. There was no need to employ the "little

cheese-headed screws" so justly criticised by Mr. Mavor, but soldered or mechanical connections could be made as desired, under screws upon which the wireman would exert his strength and not his skill. He would also like to support Mr. Geipel in his statement, or in his belief, that the Edison lamp-holder was the best yet produced, both for socket and lamp; the vibration difficulty had been entirely overcome, and the holder satisfied every requirement. Possibly the present double-plunger type was the outcome of the patent exigencies of early days. If the two papers did nothing else than indicate the necessity of standardising the present wiring appliances and accessories, they would, he hoped, have served a useful mission, and placed more suitable profits into the pockets of the wiring contractor. His belief was that they were already in a position to compete directly with the cost of gas piping. Electricians gained entire control of the electric bell and signal field, because they found out how to compete directly with the other methods in the cost of installation. They should control the lighting, heating, and power fields, when they met rival methods fairly in respect to the initial cost of installation. Insulating conduits had prejudice to overcome, just as the other innovations of the modern days. Take for example the "new woman." That comparison at first sight might appear long drawn, but looking closer at the phenomena they found they were both intimations of changed economical conditions, which necessitated a scientific curtailment of valuable material, and, further, it was necessary to have an effective disposal of the material employed. He quite admitted that at present they were, as it were, only in the gun barrel stage of early gas fitting practice, but the demand, and consequent price of insulating tubes, depended upon them. It might be of interest for them to learn that in spite of difficulty and opposition, the last nine months had not been wasted in respect to the particular system he advocated, for, thanks to the co-operation of the General Electric Company, they could estimate that some 25,000 incandescent lamps in England were already testing the merit of conduit methods. He had to thank Messrs. Christy Brothers, Chelmsford; Page & Miles, Brighton; Mr. Barrett, Cambridge; and Messrs. Strode & Co., of London, as being prominent among contractors who had had the courage of their convictions in adopting this method of wiring, and Messrs. Kincaid, Waller and Manville, and Mr. George Wilkinson, amongst the consulting engineers who had advocated it. So far, he had only dealt with the criticisms made on his own paper, but if it would not try their patience too much, he would like to refer to points of resemblance and dissimilarity between Mr. Mavor's paper and his own. First, as to the points on which their papers were agreed. He was at one with Mr. Mavor in his witty and amusingly incisive remarks as to the employment of wood casing; the difficulties of the present-day contractor and wireman; the inefficacy of present I.R. tests and insurance inspection; the evils of indiscriminate fusing, and the value of working from centres of distribution; the room for improvement which exists in the detail of switches, cut-outs, &c. He would wish to supersede wood casing entirely, even for ordinary work. Perhaps it might be in some sense considered a technical triumph for English contractors to be able to point to present-day results, but wood casing methods had never developed a complete system, and must always be uneconomical commercially. Time alone would show how far they merited continued confidence. He would obviate the troubles of the present-day contractor by giving him a standardised system, and one for which sound and practical arguments could be advanced. That would give wiremen plenty of work, because ultimately it would open up a field as extensive as gas piping. As the gas fitter found his employment slipping away we would wish to have him trained up to electric piping on conduit methods, and on that head he should not clash with Mr. Mavor, who expressed a decided preference for the plumber. In America that change had already commenced, and the wireman gas-man was called in the vernacular the Hoodoo gas-man. He preferred him to Mr. Mavor's Hindoo tinsmith. If he might again parody Mr. Mavor's words he would overcome the shortcomings of I.R. tests by providing an accessible system which possessed an inherent insulation under all conditions, and had the ability to defy the approach of the charwoman with her wash-bucket, the insidious action of a Scotch mist either in the tube or on the walls, the nail of the carpenter or amateur picture hanger, the heel of the wireman's boot, or the playful experiments of a budding, though perhaps too inquisitive electrician. Under those conditions insurance inspectors would be at a discount. There was a noticeable similarity in the fuse and intersection box system of distributing both in concentric and conduit systems. His efforts were being concentrated on the improvement and standardisation of detail accessories, and he looked for encouragement from all contractors, and that Institution. Coming to points on which Mr. Mavor was open to challenge, and he (Mr. Bathurst) was tender, Mr. Mavor said as far as he was aware no system of concentric wiring in which "both inner and outer conductor were insulated" had ever been used for indoor work. In his reply he told him (Mr. Bathurst) the "outer conductor" which he showed in one of his illustrations, was *eccentric*. Seven years ago they developed this method of placing one conductor around the other, but their experience convinced them that in an insulating tube it offered no advantage over twin parallel, or separately insulated conductors, and entailed considerable difficulty and disadvantage in respect to jointing and connecting. He agreed with Mr. Mavor, it was eccentric. When quoting the difficulties the Admiralty had had with ordinary double wiring, Mr. Mavor said that their comparative failure "admirably illustrated the difficulty of designing waterproof fittings for use in a double-wire system where the two sides of the circuit must be insulated from each other, and both from the metal of the containing boxes." As that was exactly the problem they had overcome, he hoped that the attention of the Admiralty would be called to his (the speaker's) interior conduit system; he employed double wires, armoured insulating pipes and boxes, hermetically sealed throughout and provided thereby, electrical and mechanical protection from switchboard to lamp-holder. In fact, he feared he must challenge Mr. Mavor to show the superiority of the concentric system at any one point—mechanically, electrically, or commercially. Again, Mr. Mavor attacked the old methods of double wiring, and pointed out its faults in order to prove the superiority of his system. If one had inclination, it was easy to take his own words on slips three, five, and seven, and put them together, so as to prove that his lead covered or wire armoured concentric system was just as vulnerable on the very points he tried to make. He (Mr. Bathurst) submitted that they did not hold against an armoured conduit system. The detail points Mr. Mavor's system could be criticised upon were his armouring and his joints. Omitting all possibility of mechanical damage when he embedded his present wires directly in the wall, did he maintain that they were practically imperishable? If so, he feared that time would show that air and moisture could produce sufficient natural corrosion to correct his present feeling that his system is quite ideal. It was also noteworthy that Mr. Mavor's co-concentric pioneer, Mr. Andrews, in the new system he was developing, made a feature of a *complete* copper tube as the outer conductor. Whilst he appreciated the ingenuity with which Mr. Mavor worked out his metal joints, he considered that it was open to criticism, at least, from its electrical functions. Poor joints heated, and caused trouble. They had taught their wireman that he should never depend entirely upon solder for a jointing connection; even if he must occasionally use it as a fuse. He had been told to make a mechanical connection, and rely upon solder to make it airtight. It seemed to him (the speaker) that Mr. Mavor required his solder to fill a current-carrying function. He understood him to recommend that each of his joints should be tested after it was made; but he would like him to explain either that it was quite impossible to make a poor joint, or else point out how his test must show it up His experience was that few men could use a soldering bolt or blow-lamp properly, or did so, even if they knew how. With that idea in his mind, Mr Mavor's joint appeared both costly and inconvenient. Success might be obtained with experienced men, but the difficulty would be to train them, and feel certain of the ordinary careless man. At any rate the simplest method of jointing would be preferred, and given his choice of two evils, he (Mr. Bathurst) would rather chance an ordinary mechanical connection under a screw head. He might be prepared to use one lock-nut with it if absolutely necessary. It appeared to him that Mr. Mavor took what he wanted to have recognised as an "iron chain," and asked his workmen to put any number of "string" links into it. The main objections he made to the concentric system Mr. Mavor so admirably and forcibly advocated, and sooner or later those points would have to be fully discussed, were lack of accessibility, or if they preferred it, reliability, and the grounding of the outer. Accessibility he had already accentuated, but he thought conviction grew upon one the more the point was discussed. Mr. Mavor twitted accessibility as a "relic of olden days." It might be so, but there were many engineers who would cherish it for some time to come. He would not take Mr. Mavor's own words to prove its desirability in case of an accidental short circuit, but left it with the suggestion that concentric conductors had better not be overloaded, and should be carefully removed from any chance or unexpected electrical and mechanical trials. He suggested that without accessibility the use of concentric wiring was foredoomed entirely to surface work, and even then would give only a pre-determined and limited service without absolute reliability. As regarded grounding the outer, that one question could be discussed with an evening to itself. Even admitting the desirability of earthing the outer in street mains, personally he did not see the wisdom of enlarging the distributing network *ad infinitum* by including customers' premises. That end, he would rather suppose, should exist only with both wires insulated. The consumers' wires had to be installed under every kind of trial, contiguous with gas and water systems, and passed over steel girders and other metallic constructions. Would Mr. Mavor have all those earthed as well, as if not, he feared hazardous conditions would arise? The risk of electrolysis might be greatly over-estimated, but the troubles referred to in America had, he was creditably informed, convinced the authorities that even $\frac{1}{1000}$th of a volt difference of potential was too much, and meant deterioration, if not destruction to gas and water pipes and other metallic bodies in the vicinity. After listening to Mr. Mavor's eloquent exposition of the advantages of a grounded outer, he was surprised when on his last page he suggested two simple remedies which might be adopted. He should like to have heard some discussion on that point, particularly when they had heard Mr. Andrews express his pet ideas, and they found the two champions at variance. Mr. Mavor seemed to imply the necessity of keeping intact (by a protecting lead sheath) a light insulation over the whole length of the outer conductor, except at distant ends. That being so, he asked him why not keep a slightly heavier one, and, following Mr. Andrews's leadership, use an iron armour instead of a copper tube, and having got so far, he (Mr. Bathurst) should by preference suggest that two insulated conductors be put inside it. Mr. Crompton seemed to believe that it would be possible to use one well insulated wire inside an iron pipe; when this time came, he (the speaker) would try and prove the commercial advantage of employing a *bare* conductor in an armoured insulating tube. He owed an apology to Mr. Mavor for thus criticising his distinguishing points, but he would as readily acknowledge and praise the thoughtful care with which the details of a complete system has been worked out. He could endure this criticism from his rival, as everyone else had let him off so easily, and returning to his first metaphor, it might be that Mr. Mavor was, after all, a bigger boa constrictor than he (Mr. Bathurst) was, and that by his exertions he would, as it were, swallow him up, so that he would be *concentric* with him. He faced this position with equanimity, because he would then be found the warmest advocate of an armoured insulating tube *system* with one "accessible" conductor inside.

HIGH VOLTAGE LAMPS, AND THEIR INFLUENCE ON CENTRAL STATION PRACTICE. By G. L. ADDENBROOKE, Member. Paper read February 27th, 1896.

(*Continued from page* 360.)

But before going into these matters further, we must settle what shall be our greatest drop from the feeder point to our furthest lamp on the network spreading from it. The variations which are permitted at present are too great, and would have to be reduced in time anyhow. I therefore do not intend to adopt the present practice as a basis, but to take as the limit an extreme fall of 2 per cent. on the distributing system from the feeder point to the furthest lamp at the tops of the houses; that is, lamps near the feeder would be 1 per cent above their proper voltage at full load, and extreme lamps 1 per cent. below.

This is, I think, as large a variation as good practice would allow, though it is less than half what is considered permissible now. Having settled this, the following data and table will enable us to see at a glance the best method of designing the mains, and their cost.

1. A bar of copper 1 inch in section and 1 mile long weighs approximately 9 tons, and its resistance is $\frac{1}{22}$nd ohm, or 0·045.

2. Therefore, a double conductor 1 mile long and 1 inch in section weighs 18 tons, and its resistance is $\frac{1}{11}$th ohm, or 0·090.

3. I do not think it will be necessary on the high voltage system to have the third wire in a three-wire system more than one-fifth the section of the other two, except, perhaps, in the distributing system. In fact, I understand Mr. Crompton considers the third wire could be done away with altogether as soon as the feeder gets a good load joined up to it, so that only the distributing system would need the third wire, these wires being joined together at the distributing point.

Consequently, the weight of a set of mains on the three-wire system—the two outers 1 inch section, and the inner $\frac{1}{5}$th of an inch—would be 20 tons per mile; and the cost for copper at 6½d. per lb. would be £1,210 for the copper in the mile of mains.

Now, at 1,000 amperes per square inch a main this size would carry current for 6,000 16-C.P. lamps, if perfectly balanced on the above basis, and the fall of pressure would be 90 volts in the mile, or 17 per cent. Such a fall of potential as 17 per cent. in the mile is excessive, and therefore we must arrange to work at a smaller current density.

To enable the best current density to be judged, I have arranged the following table:—

DATA RELATING TO FEEDERS ON THREE-WIRE SYSTEM SUPPLYING 220 VOLT LAMPS—$\frac{1}{3}$ AMPERE PER 16 C.P., AND $\frac{1}{8}$ AMPERE PER 8 C.P. LAMP.

Current density in amperes per square inch.	Loss in volts per mile of double conductor.	Percentage fall of potential at full load.	Kilowatts available per square inch section of outers = 2·2 square inches copper.	Number of lamps carried by mains 1 square inch section = 2·2 square inches copper.		Cost per mile of copper at 6½d. per lb.			
						Per lamp alight at once.		Per lamp installed = twice lamps alight.	
				16 C.P.	8 C.P.	16 C.P.	8 C.P.	16 C.P.	8 C.P.
		Per cent.				s. d.	s. d.	s. d.	s. d.
1,000	90	17	440	6,000	12,000	4 0	2 0	2 0	1 0
500	45	9 3	220	3,000	6,000	8 0	4 0	4 0	2 0
400	36	7·6	176	2,400	4,800	10 0	5 0	5 0	2 6
300	27	5·8	132	1,800	3,600	13 5	6 8	6 8	3 4
250	22·5	4 86	110	1,500	3,000	16 0	8 0	8 0	4 0
200	18	3·85	88	1,200	2,400	20 0	10 0	10 0	5 0

This table enables us to see the reduction in fall of potential which we get by reducing the current for a given section, and also the cost for copper which will be incurred for such density per mile run.

Now, it is not unusual in some low-pressure central stations to have falls of even more than 16 per cent. at full load on the longest feeder; but this is an undesirably great fall, save on exceptional occasions, such as Christmas week, or during a fog in winter, and I think, with the immense reduction in copper cost which the use of high-voltage lamps gives, it is desirable to work with smaller falls.

Suppose we accept 250 amperes per square inch as a basis, it will be seen that mains on the three-wire system will cost us 16s. per 16-C.P. lamp alight at once, and 8s. per 8-C.P. lamp per mile, and the drop of potential will nearly be 5 per cent. Now, if we assume that current is supplied 2½ miles from the station as an extreme, as we did before, our longest feeders will be about this length, the drop at full load on the feeder will be about 12 per cent., and the cost of copper 40s. per 16-C.P. lamp, and 20s. per 8-C.P. lamp alight at once for the longest feeder.

If we take the network as proceeding from the feeder points at the same current-density—namely, 250 amperes per square inch—and if we agree that it shall extend rather over a quarter of a mile from the feeder point, to allow for irregularities, so that each feeder will feed a network covering half a mile square, it will be noted that the drop, including extra lengths of main for going round angles and into the houses, will be about 1½ per cent., and the extreme cost of copper per lamp alight at one time in the network will hardly be more than 4s. per 16-C.P. lamp, and 2s. for an 8-C.P. lamp, while the mean cost will be about three-fourths of this, and the mean drop of potential only 1 per cent.—and even this can readily be reduced by a little judicious adjustment.

We therefore see that for feeders extending about 2½ miles, and a network extending a quarter of a mile further from the feeding point—that is, 2¾ miles altogether—the extreme cost for copper per 16-C.P. lamp lighted at once will be about 44s., and for an 8-C.P. lamp under 22s.

This represents extreme lengths. The average length of feeders to cover the above area would hardly be more than 1¾ mile, or three-fourths of the above maxima; and the cost of the copper, on the average, in the distributing system, will be produced in like proportion. We shall, therefore, be correct in taking three-fourths of the above sums as the average cost of copper per lamp lighted at once from station to lamp, including both feeder and network, in a station covering a town area of equal density 25 square miles in area. This is, approximately: Per 16-C.P. lamp, 33s.; per 8-C.P. lamp, 16s. 6d.

Further, from practice and the tables in *Lightning*, we know that there are usually at least twice as many lamps installed as are required alight at once; therefore, we may put the capital cost of mains for copper only at about: Per lamp installed: cost of copper—16-C.P., 16s. 6d.; 8-C.P., 8s. 3d.

Now, it is fair to take 6 per cent. per annum as the sum to allow for interest and depreciation on the copper in the mains—say, 3½ per cent. for interest, and 2½ per cent. for depreciation. At this rate, on the above capital cost, the annual cost for interest and upkeep comes out at under 1s. per 16-C.P., lamp, and 6d. per 8 C.P. lamp installed.

Further, on looking through the tables of consumption of current, it will be found that 18 units per 8-candle lamp installed is a fair all-round average—at least, it is the average from *Lightning* for London and most of the provincial stations. At this rate, therefore, it will be seen that the upkeep and interest on capital for the copper in the distributing system comes to 0·33d., or one-third of a penny per unit of current sold; or, supposing the sum actually received for current is 6d. per unit, the cost for interest and upkeep on the copper in the distributing system represents less than 6 per cent. of the cost of current. Out of this cost, it will be noticed that about three-fourths of the copper is in the feeders, and one-fourth in the distributing system.

I may say that Mr. Crompton objects to the method of taking the consumption per 8 C.P. lamp installed as a basis of comparison, and I quite agree that it is rough and unscientific; and it might be well if our friend the editor of *Lightning* would look into it, and see if he could not get a sounder basis for comparison.

Mr. Crompton suggests the relation between the annual output in B.T. units, and the output which would be registered if the maximum load were continued day and night throughout the year. In this case he tells me the actual output would vary from the equivalent of full load for 700 hours in some country towns to 1,000 in parts of London, 1,300 in Kensington, and a much higher figure for the Pall Mall and St. James's Company. 1,300 hours corresponds to a load-factor of 15 per cent.; though it will readily be seen that it is a figure of more comprehensive nature, and not exactly similar.

I leave this question here, however, as, though very interesting, to discuss it further now would be out of place in this paper.

In order to complete the comparison made above, the cost of insulating and of laying the cables should, of course, be taken into consideration.

In order to set this point at rest, Mr. T. O. Callender has kindly prepared for me data deduced from their experience in supplying and laying cables, which, as the result of a large amount of practice, are beyond cavil, and which show the average cost of cables laid as compared with the cost of the copper in them. These particulars are given in the following table.

Under asphalte or wood, the cost of excavation will run up to as much as 15s. per yard run, but this item will practically be the same whatever system is used. Moreover, as only a few of the main streets in large towns are so paved, this item is not one which need concern us particularly in a general comparison, but must be dealt with in accordance with local circumstances in each case.

It will be noticed that in the above table the middle wire is half the section of the outers; in practice, it would not be necessary to have this more than one-fifth for the feeders, and in some cases it might be omitted entirely. The actual cost of feeders should, therefore, come out about 10 per cent. under the prices given, though I have thought better to leave the table as it was, preserving Mr. Callender's own figures.

At these rates, for a two-mile feeder of armoured cable, working at a current density of 250 amperes per square inch, the cost, laid complete, would be about £55 per kilowatt for the maximum output;

the fall of pressure being about 10 per cent. I think, therefore, that the whole distributing system—consisting of feeders, branches, local services, service boxes, and every other item, also providing for a fair proportion of the cables being laid under asphalte or wood, from such a station as I have described above, with a service extending 2½ miles in all directions—could be laid complete for £60 per kilowatt.

TABLE SHOWING THE TOTAL COST OF INSULATED CABLES LAID COMPLETE, AS COMPARED WITH THE COST OF THE COPPER CONTAINED.

Character of cables (separate).	Armoured, laid direct.	Plain, laid in solid bitumen.	Armoured, laid direct.	Plain, laid in solid bitumen.
Area of cable { Outer ... / Middle ... / Outer ..	Sq. inch. 0·50 / 0·25 / 0·50	Sq. inch. 0·50 / 0·25 / 0·50	Sq. inch. 1·00 / 0·50 / 1·00	Sq. inch. 1·00 / 0·50 / 1·00
Cost of cable laid complete, exclusive of excavation	19s. per yd. £1,650 per mile.	25s. per yd. £2,200 per mile.	33s. per yd. £2,900 per mile.	42s. per yd. £3,700 per mile.
Excavation, cheap streets and lanes	s. d. 1 3	s. d. 1 3	s. d. 1 3	s. d. 1 3
Excavation per yard, average run of trench in towns under macadam or pavement ...	2 0	2 0	2 0	2 0
Ratio of cost of copper (at 7d. per lb.) to cost of complete cable laid, as 1 ...	2·5	3·1	2·2	2·3

This is a very moderate figure as compared with the sums now spent. If we assume that 8 per cent. is required to meet interest, upkeep, and depreciation on this outlay, and if we take the output of the station at 800 kilowatt-hours maximum load on the basis suggested by Mr. Crompton, it is evident that interest and upkeep on the distributing system would cost about 1½d. per unit of current sold for the whole distributing system; so that a charge of 1½d. per unit would cover all costs outside the station itself. From what we know of the cost of generating electric energy, it will, I think, thus be clear that, even in places where coal was expensive, a very good profit would be made by selling current at 4d. per unit for lighting, and 2½d. for power purposes. In making this calculation I have assumed the same density of population over the whole area; but it is evident that this would very seldom be the case, as in nearly all towns at two miles from the centre the density of population is greatly reduced, which would mean a smaller proportion of long feeders, and consequently a less average cost per kilowatt output than I have taken.

I do not wish it to be assumed from what I have said above that the capital cost of a direct supply station at 220 volts, with feeders and distributing system extending 2½ miles, as described above, would be as low as that for an alternating station at 2,000 volts, with transformers and 220-volt lamps, to cover the same area. It would not. Comparing feeders, I think, with the present prices of mains, and using the same class of insulation in each case (as is frequently done now)—that is, not using expensive rubber cables for the high tension—the two systems are equal in cost for feeders 1½ miles long. As the distributing system will extend ¼ mile further beyond the end of each feeder, a direct supply station on exactly the same line is as cheap in capital cost for an area having a base of at least 3½ miles and covering 10 square miles. Further, as something must be allowed to the direct supply system on account of lower depreciation, and greater safety and freedom from restrictions, and ability to supply motors more easily, another quarter of a mile may easily be allowed on the feeders of the direct supply station on this account; so that the systems compare together when the base of the area served is 4 miles, and the area itself 16 square miles, even if no accumulators are used.

Although this is not as large as the area I have taken as a basis, what it means can be estimated from what has been said above as to the actual areas covered by large towns. I am, of course, assuming that 220-volt lamps are used on the transformer station as well as the direct. If we assume that the transformer station employs 100-volt lamps, of course the comparison would be much more decidedly in favour of the direct supply at 220 volts.

There is no need, however, to go very minutely into these figures, because, though thoroughly practical, they do not represent what it is clear will be central station practice in the future, as I do not think it probable that any direct supply station in the future will be operated without accumulators.

THE USE OF ACCUMULATORS.

This brings me to the fifth and last point mentioned at the beginning of my paper when enumerating the possibilities likely to affect central station practice in the future, viz., *the use of accumulators.*

In the earlier part of 1891 I did not see much likelihood of improvements in accumulators making any really fundamental alteration in central station practice. But I must confess that in this respect events have moved faster than I anticipated, although I have been brought sufficiently into contact with them to learn what was going on in the field, and how batteries were doing as regards upkeep.

Up to comparatively recently, there is no doubt accumulators have been rather a luxury and convenience in central stations than a commercial or economical necessity; but during the last two or three years considerable changes have been taking place. The maximum safe discharge rate for accumulators has been going up, while the initial cost has been going down, as well as the cost of upkeep; and extended experience holds out the hope of much longer life for the newer and improved forms of positive plates than has hitherto been the rule. Owing, also, to the method of supplying accumulators at a maintenance rate adopted by the leading firms, an engineer need have less hesitation in recommending clients to incur a large expenditure on them, and the risk is much less than formerly. Patents are also expiring, and considerable competition is arising in this trade, which was formerly such a close one.

I have lately had to make careful inquiries about accumulators in connection with work on which I am engaged, not only as regards prices, but also as to their working, and, having got particulars about the batteries in several central stations, and held conversations with the engineers concerning them, have been considerably surprised at the progress which has been made. Taking quotations from leading makers for a battery suitable for a central station, I find that the capital cost of a battery to discharge at 1 kilowatt for three hours is as nearly as possible £13 for the battery alone. Several makers assure me that such a battery can be discharged at this, and even higher rates, every day regularly, without detriment or endangering the life of the positive plates. The above price does not include buildings to contain the accumulators, connections, instruments, or stands to hold them, which bring up the cost to about £19 per kilowatt on this basis for central station batteries. The makers tell me, further, that they are willing to enter into contracts to maintain such batteries in a state equal to new for about 6 per cent. per annum on their capital cost, and some makers will even go lower than this.

It will be found that these costs and rates of renewal are a great improvement on those ruling until comparatively recently.

Now, I should not quote these figures unless I had, by private inquiries and in other ways, fairly convinced myself of their substantial accuracy.

Granting that they are so, it appears to me that they raise questions of very serious import in central station practice, particularly when coupled with the use of higher voltage lamps.

If an accumulator will give a discharge for three hours—that is, sufficient to cover the period of heavy load, or the time during which the large portion of the plant has to be kept running—a kilowatt capacity of accumulators will be equivalent to a kilowatt capacity in engines and dynamos.

In continuous-current stations, when an increase of output is required—which is from time to time the position of most stations—we are therefore brought face to face with this problem.

Extra plant for 200 kilowatts output, say, is required. Which is the best way of providing for it—by adding engines and boilers, or by adding accumulators and charging them during off hours from the existing plant?

Now, as I have said above, an accumulator for an extra kilowatt output will cost about £19 complete and erected, including buildings; and I think engineers will generally agree with me that engines, boilers, dynamos, and steam-pipes for a kilowatt output, including buildings and all other accessories, would cost about the same sum; if foundations, flues, chimney stalk, and everything else were considered, the comparison would be slightly in favour of accumulators. However, for our present purpose, let us assume that they are equal. We have, therefore, arrived at the position that the capital cost will be equal, whether we provide extra plant or extra accumulators for the increased output required, charging the accumulators from the existing plant.

As regards upkeep, if we can keep the accumulators in an efficient state for 6 per cent. on their cost, this is not greatly in excess of what would have to be allowed on plant if boilers are included; and, at any rate, the difference is not a matter of very great moment.

There is no need to say anything here on the extremely low cost at which energy can be produced if a continuous load is provided night and day.

Considering the advantages accumulators give in a central station in providing for emergencies, reducing staff, and keeping the pressure even, it is, I think, doubtful if an engineer placed in the position indicated above—as many engineers will be placed shortly—would not be wise in recommending his corporation or his board to instal accumulators for 200 kilowatts output for three hours, instead of the extra plant, when the plant was a continuous one.

How far this should proceed is a moot point, dependent upon circumstances, which would need decision in each case. Possibly somewhere about one-third the maximum full-load capacity would be about right now, but with a load-factor of 10 to 15—which is about that general in central stations—if the price of accumulators came down per kilowatt output—which I think it is likely to do in the future—or their efficiency increased, it might be found desirable to instal accumulators for as much as two-thirds, or even three-fourths, of the full load, which would place electric distribution nearly on a par with gas distribution in respect to storage.

To go as far as that is, however, not a question of the present—at any rate, in most cases—and, therefore, for our purpose this evening I propose to consider the accumulators as desirable for about one-third to one-half the full output.

(To be continued.)

The Société Internationale des Electriciens.

THE monthly meeting of this society took place March 4th, 1896, with M. Violle in the chair. After the list of new members and works submitted to the society had been read, the secretary informed the members of the invitation from the Swiss Society of Electricians to attend a Swiss congress to be held from May to October. It was also announced that the general assembly would take place at the next sitting. Dr. D'Arsonval then read a paper on "The Medico-Surgical Applications of the Röntgen rays." He observed that up to the present it has only been possible to obtain photographs through slight thicknesses. We have been able to get photographs of the interior of the hand, the arm, the elbow, but not of the thigh. To

succeed, the operator must be above all a good photographer. Dr. D'Arsonval mentioned the photographs obtained by M. Loude and by M. Imber, professor of physics at Montpellier. M. D'Arsonval then showed projections of various photographs taken in the ordinary manner, and with the Röntgen rays, such as a pigeon, the wing of a pheasant, a sewer rat, a white mouse, a rabbit. All these photographs were very remarkable. He then showed some proofs obtained by Dr. Oudin in various diseases, such as ostitis. He concluded by observing that greenish incandescence lamps are also suited to the X rays. Mr. Charles Henry showed that photographs could be obtained with the intervention of phosphorescent sulphide of zinc. M. Becquerel obtained the same results with salts of uranium. Dr. D'Arsonval said that he had used a Geissler tube placed in a glass tube filled with fluoresceine. This tube was fed by a Ruhmkorff coil and placed at a distance of 10 centimetres from a photographic plate wrapped in several thicknesses of black paper; photographs were obtained of a key, some gearing mechanism, some crystals of uranium, &c. It follows, therefore, that the fluorescent rays alone would act in the Röntgen experiments.

M. G. DE LE TOUANNE then read a paper on the installation of the Hôtel des Téléphones, Paris. He gave a few general details, but did not bring forward anything of great interest.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents*, 31, *High Holborn, London, W.C., to whom all inquiries should be addressed. Copies of any of the specifications may be obtained of* Messrs. W. P. THOMPSON & Co., *price, post free*, 8½*d. (in stamps.)*]

NEW PATENTS.—1896.

4,632. "Improvements in dynamo-electric generators and motors." F. H. ROYCE and E. A. CLAREMONT. Dated March 2nd.

4,701. "Improvements in electrically and automatically actuated shooting targets or butts." J. NEUHOLD. Dated March 2nd.

4,748. "An arc lamp for optical lanterns, stage and yacht projectors, or other purposes." A. J. BEAUMONT. Dated March 3rd.

4,761. "New or improved device for facilitating the fixing, adjustment, and removal of electric incandescent lamps." F. H. COULSON. Dated March 3rd.

4,773. "Improvements in electric traction." J. CLARET and O. VUILLEUMIER. Dated March 3rd.

4,774. "Improvements in and connected with automatically operating variable resistances in electrical circuits." C. B. CALLOW and H. BEVIS. Dated March 3rd.

4,778. "An improved method of obtaining electricity." B. F. DA MOTTA. Dated March 3rd.

4,788. "An improved method of process or converting the potential energy of carbon or carbonaceous materials into electrical energy." W. W. JACQUES. Dated March 3rd.

4,805. "Improvements in method of and apparatus for magnetic separation." J. P. WETHERILL. Dated March 3rd.

4,806. "Improvements in magnetic separators." J. P. WETHERILL. Dated March 3rd.

4,807. "Improvements in monocyclic electric generators." J. DEVONSHIRE. (E. Thomson, United States.) Dated March 3rd.

4,808. "Improvements in safety appliances for electric brakes." J. DEVONSHIRE. (W. B. Potter, United States.) Dated March 3rd.

4,817. "Regulating mechanism for electric arc lamps." E. LAVENS. Dated March 3rd.

4,837. "Improvements in or connected with circuit closers for electric bells." J. NEWTON. Dated March 3rd.

4,844. "Improvements in electric arc lamps." T. E. ADAMS. Dated March 3rd.

4,845. "Improvements in electric arc lamps." T. E. ADAMS. Dated March 3rd.

4,864. "Improvements in or in connection with electric motors, specially applicable to electric motors for tramway cars." F. M. LEWIS. Dated March 4th.

4,870. "An improvement in the method of forming the electrical connection between portable electric table-lamps and the current conductors." A. DENNY and J. KEMPTON. Dated March 4th.

4,910. "Improvements in magnetic regulating and actuating mechanism." R. NIEWERTH. Dated March 4th.

4,937. "Improvements in plates, grids, or supports for the elements of secondary batteries." E. CLARK, W. CLARK and F. KING. Dated March 4th.

4,944. "A new or improved electric arc lamp, carbon, and apparatus for the manufacture of the same." J. G. LORRAIN. (T. M. Foote, United States.) Dated March 4th.

4,959. "Improvements in electric arc lamps." A. G. EDWARDS and J. BAKER. Dated March 4th.

4,964. "Improvements in the brackets or supports of incandescent electric lamps." J. CARTER and W. J. WHITING. Dated March 5th.

4,996. "Improvements in jointing boxes for conduits carrying electrical conductors." F. BATHURST. Dated March 5th.

5,001. "Search-light reflectors." R. B. MOLESWORTH. Dated March 5th.

5,008. "An improvement in commutator brushes." W. W. WARDLE. Dated March 5th.

5,018. "An improved electric bobbin or solenoid." S. S. BROMHEAD. (A. Dorez, France.) Dated March 5th.

5,023. "Improvements in or relating to electric railways and tramways." G. C. FRICKER. Dated March 5th.

5028. "Improvements in telegraphy, and in apparatus therefor." G. MARCONI. Dated March 5th.

5,041. "Improvements in conductors for telegraphs, telephones, and electrical distribution." J. SWINBURNE. Dated March 6th.

5,069. "Improvements moderating electric incandescent lamp and apparatus for that purpose." G. BAMBERG. Dated March 6th.

5,098. "Improvements in electrolytic processes and apparatus therefor." G. B. BALDO. Dated March 6th.

5,113. "An improved electro-plating bath." S. PITT. (W. B. Hollingshead, United States.) Dated March 6th.

5,168. "A method of effecting electrical communication with a train and apparatus for that purpose." A. C. BROWN, R. BURN and L. G. TATE. Dated March 7th.

5,171. "Improvements in lifting and lowering gear for electric arc lamps, electroliers, and the like." B. R. BAKER. Dated March 7th.

5,178. "Improvements in or connected with locomotives, also applicable to tramcars, electric cars, carriages, and other vehicles." E. LEVER. Dated March 7th.

5,191. "Improvements in arranging underground electric current conductors for electric railways, and in means for making contact therewith." A. PETZENBURGER. Dated March 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

1895.

437. "Improvements in and connected with electric arc lamps." J. B. BARTON. (W. Jandus, U.S.A.) Dated January 7th, 1895. Relates to an arc lamp in which the operating mechanism comprises an annular armature surrounding one of the carbons with a coil acting on the armature in conjunction with a clutch mechanism. The arc is enclosed in a substantially air-tight chamber, as described in specification 437A, of 1895. 7 claims.

3,076. "Improved combined telephone and telegraph systems." H. H. LAKE. (C. A. Shea and F. F. Raymond, U.S.A.) Dated February 12th, 1895. Relates to a system of joining telegraph and telephone instruments with a single line having an earth return, or with a complete metallic circuit so that each wire can be utilised to its fullest extent at the same time both telegraphically or telephonically. Various arrangements of condensers and resistances joined with the instruments are shown and described. 17 claims.

4,352. "Improvements in dynamo electric machines and motors." L. B. ATKINSON. Dated February 28th, 1895. Relates to the provision of means for applying a reversing electromotive force to the armature coil to be commutated. By this device the output of a given weight of machine is increased, and the brushes are enabled to be fixed in an invariable position for all loads without sparking at the brushes being caused. 3 claims.

5,875. "Improvements in and relating to conduits for electrical conductors." F. L. MUIRHEAD. Dated March 20th, 1895. The conductors are laid in earthenware spigot and socket conduits, with suitable insulating bridges above and below to keep the conductors away from the conduit. The whole is then filled up with a melted material consisting of paraffin wax and powdered pumice stone, or other pulverised silicated material. 4 claims.

5,936. "A current collector for electrically propelled railway or tramway vehicles." SIEMENS BROTHERS & Co. (Siemens and Halske, Germany. Dated March 21st, 1895. The conductor is attached to the roof of the conduit, and on one side of the aperture. The collector is formed of a thin hollow arm mounted on the vehicle and projecting through the continuous slot formed in the rail, into the underground conduit. To the lower part of this arm is hinged a lever which carries at its end a rubber. In the contact position the lever is horizontal to the hollow arm and presses its rubber against the conductor. The lever may with the rubber be folded close to the arm, so that the whole can be withdrawn by swinging the arm on a horizontal axis. The lever is controlled by a rod working in the hollow arm. 4 claims.

6,075. "Improvements in electric switches." W. J. DAVY. Dated March 23rd, 1895. Consists in arranging all the insulated contact surfaces to form a part of a common cylindrical surface, the desired connections being made by a sliding cylindrical contact surface, and adapted to slide axially. Different arrangements of switches are described for different purposes. 3 claims.

19,374. "Improvements in incandescent electric lamps and the method of making the same." S. E. COX. Dated October 15th, 1895. Relates to lamps in which the bulb filament support and seal are made of a single piece of glass. The leading-in wires are sealed into extensions from opposite sides of the neck, and the exhausting tube is a continuation of the neck. No protuberance is left at the bottom of the bulb. 6 claims.

23,354. "Improvements in electrical heating devices." FERNAND LE ROY. Dated December 5th, 1895. Consists in forming the resistance pieces which produce the heat of silicon. These bars of silicon which may be of any shape, are supported preferably on platinum cones which also form the contacts, these latter being themselves supported on small electric carbons. 2 claims.